AN EVALUATION

OF THE

SPEED HUMP PROGRAM

IN THE

CITY OF BERKELEY

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EXECUTIVE SUMMARY

The City of Berkeley has been using speed humps to control vehicle speed on residential streets since 1990. There are currently 156 speed humps on 99 blocks in the City. From the start of the program, it was assumed that a full evaluation of the effectiveness of speed humps would be performed. In addition, the growing use of the speed humps has raised some concerns about their impact on emergency services and disabled residents. In July of 1995, the City Council delayed any further speed hump installation until an evaluation of the program could be completed, one that considers not only speed hump effectiveness but also the full impact of the devices and alternatives to them. This document serves as that evaluation. The findings of the study and recommendations for a revised program are summarized below.

- **Residents' Opinions**. Berkeley residents in speed hump areas clearly support the speed hump program. Of residents on streets with speed humps, 57% support the installation of more humps and 25% had no opinion. On streets without speed humps, 46% support the installation of more humps and 23% had no opinion. Residents feel that speed humps have generally been effective at reducing traffic speeds. They feel that speed humps have had much less impact on traffic volume, street noise and crime. Residents are concerned about the delay to emergency vehicles, though only 33% feel that this is reason to discontinue the program.

- **Impact on Traffic Speed**. Studies in Berkeley and in other cities show that speed humps are extremely effective at reducing traffic speeds, particularly the highest speeds that are most troubling to residents. Properly spaced speed humps reduce traffic speeds both at the humps and between the humps, and speeds have not crept back up over time.

- **Impact on Traffic Volume**. Studies done in Berkeley and other cities indicate that speed humps generally decrease traffic volume on the street where they are installed, and have the potential to divert a significant amount of the traffic to other local streets. If a parallel local street is equally convenient to through traffic, it is likely that it will receive diverted traffic. Traffic diversion of this nature can have a significant impact on surrounding residential streets.

- **Impact on Emergency Services**. Speed humps can cause significant delay to Fire Department vehicles, including ambulances. Records from the Fire Department are not extensive enough to determine if speed humps have led to an increase in average response time. However, tests show that fire vehicles driving on a typical block with speed humps can experience a delay of up to 10 seconds per hump. Passing over several of these blocks would add considerably to the average response time goal of 4 minutes. Emergency vehicles that do not slow down sufficiently at speed humps could suffer expensive damage to the vehicle framing. Because of the delay they cause, speed humps can increase the risk that residents will suffer from fire damage, injury or even death. At this time, it is not possible to accurately estimate the level of this additional risk. Speed humps have less impact on Police

Department operations.

- **Impact on Disabled Residents**. Driving or riding over speed humps can cause pain for residents with certain physical conditions. For most of these residents, the problem can be minimized by driving very slowly over the humps. However, some persons may still have problems regardless of how slow they travel over speed humps. Riding over speed humps in paratransit vehicles can be particularly problematic as the drivers sometimes fail to slow down sufficiently. Speed humps in Berkeley can vary slightly in shape and height. Disabled residents often suffer most from this variability, as higher or steeper humps can cause unexpected jostling and pain.

- **Impact on Crime**. Two-thirds of speed humps in Berkeley were installed as part of the Special Enforcement Area program in an effort to reduce drug dealing, drive-by shootings and reckless driving. There is little evidence that they have had an impact on these activities. Anecdotal evidence suggests that speed humps have made a positive impact in some cases, often in conjunction with other neighborhood improvement measures. But conversations with Police Special Enforcement Unit staff and some limited data suggest that speed humps generally have no impact on the amount of criminal activity on a street.

- **Impact on Noise**. Speed humps will cause little or no change in noise levels. While noise in the immediate vicinity of a speed hump may increase slightly due to vehicle acceleration, scraping of pavement or rattling cargo, overall noise levels will likely remain unchanged or decrease.

- **Impact on Other City Services**. Speed humps have had no adverse impact on non-emergency city services such as garbage collection, recycling or street cleaning.

- **Impact on Accidents and Safety**. Traffic accidents involving pedestrians and other vehicles are infrequent on local residential streets, and therefore the impact of speed humps on pedestrian accidents cannot be accurately quantified at this time. Speed humps probably have little impact on overall accident rates. However, the real benefit of speed humps comes from a perceived increase in safety and liveability due to lower traffic speeds.

- **Impact on Bicyclists**. Speed humps can be uncomfortable to some bicyclists, particularly when the humps are abrupt or lack a smooth interface with the street pavement. Providing a gap between the speed hump and the curb can allow uninterrupted passage for bicyclists, but may also encourage motorists to swerve toward the curb. Limited evidence in Berkeley suggests that most cyclists do not mind speed humps, especially if they reduce traffic speed and/or volume.

- **Alternatives to Speed Humps**. Of the accepted traffic calming measures used in the U.S. today, standard 12-foot wide speed humps remain the most effective device to reduce mid-block speeds without blocking access. Other devices can be effective to a lesser degree, and

may be appropriate for some locations in Berkeley where standard speed humps cannot be used. Varying the width and shape of speed humps from the standard 12-foot wide design appears to be the most promising alternative. Specific traffic conditions or the needs of emergency vehicles can be accommodated by using wider, flatter speed humps. The 22-foot wide speed humps, such as those installed on Santa Fe Avenue in Berkeley, have proven to be effective at reducing speeds in Berkeley and several other communities, including Portland, OR, Howard County, MD and Seminole County, FL.

Chokers, chicanes and traffic circles have also been shown to reduce speeds on residential streets, though not as much as speed humps. These devices are substantially more expensive than speed humps, but they do offer the opportunity for landscaping and neighborhood beautification. Mid-block chokers should be considered for streets with speeding problems where humps cannot be installed. Large, fully landscaped traffic circles should also be considered on shorter blocks, but they will have little or no impact on long blocks. Other devices, including striping narrow traffic lanes, textured paving and stop signs, are generally not effective at reducing mid-block speeds.

- **Recommendations**. Based on this evaluation, it is recommend that the City continue to use speed humps on residential streets to control speeding problems, and that the selection process be modified so as to minimize the negative impacts of speed humps. These modifications include the following:

1) Speed humps shall not be installed on routes identified as Primary Emergency Response Routes. A proposed map of primary, secondary and tertiary response routes is included. The Berkeley Fire Department and Police Department should be consulted for every proposed speed hump installation. This review may identify streets other than primary response routes where speed hump installation would create problems for emergency response vehicles.

2) The speed hump petition form should be revised to inform residents of the delay that speed humps can cause to emergency vehicles. A proposed form is included.

3) Wider speed humps, such as 22-foot humps, should be used in situations where Traffic Engineering staff feel that they are more appropriate than the standard 12-foot wide speed humps.

4) Speed humps should not be installed or should be modified on blocks where there is an abutting resident who objects to the installation because of special medical conditions. Modification of the installation could involve lower or wider humps, or deliberately placing a hump so as to allow the resident egress from the block without passing over it.

5) Speed humps should be installed and maintained using better quality control in order to minimize their impact on residents who feel pain driving or riding over them, and to make then less obtrusive to bicyclists. Corrective maintenance should be performed on speed

humps that are too high, have ramps that are too steep, or have an interface with the street pavement which is not smooth.

6) When speed humps are installed on streets with bike lanes, care should be taken so that the humps do not adversely impact bicycle travel in the lanes. In most cases, this means that humps should not taper off within the bike lane. Instead, humps should end before crossing the lane, or should continue across the lane without tapering off.

7) The separate program for Special Enforcement Area speed humps should be folded into the regular program by modifying the priority ranking system so that points are given to locations with problems such as drug dealing or other Special Enforcement issues. A proposed ranking system is included.

8) The criteria for new installations should be modified so that only streets with clear speeding problems will be considered for speed humps. A proposed list of criteria is included.

9a) Proposed speed humps should be evaluated in terms of their impact on surrounding local residential streets. New installation should be avoided where it can be expected that a significant amount of traffic will be diverted to other local streets. After installation, Traffic Engineering staff should monitor diverted traffic, and mitigate the impacts where they are significant.

9b) Traffic Engineering staff should adopt a policy that determines what level of traffic increase is acceptable for streets receiving diverted traffic, based on a proposed Impact Threshold Curve.

I. INTRODUCTION

The City of Berkeley has a long history of trying to calm traffic on residential streets, dating back to the mid-1960's. Although speed humps only began to be installed in 1990, there are now over 150 humps in Berkeley. The City's Traffic Engineering department has monitored the effectiveness of speed humps in reducing vehicle speeds at various points during the program. However, the speed hump program has never received a comprehensive evaluation that considered their impacts beyond merely slowing down cars. Seven years after the first installation, the City now has considerable experience with the devices. This study is an attempt to gather all relevant experience with speed humps and evaluate their full impact on the city of Berkeley.

As the use of speed humps has expanded in Berkeley, several concerns have been raised which have also prompted this evaluation. Foremost among these is the concern by the Fire Department that speed humps slow emergency response vehicles. Concerns have also been raised by residents who suffer from special medical conditions that make speed humps painful to drive or ride over. In July of 1995, the City Council adopted recommendations that delayed new speed hump installation until a full evaluation could be completed. Their intent was to consider the issues, effectiveness, impacts, and alternatives to speed humps. This study serves as that evaluation.

This study was conducted by the City's Advance Planning Division, working in close cooperation with the Fire Department, Police Department and Traffic Engineering. An extensive resident survey was performed in order to evaluate opinions regarding the use of speed humps. In addition, the experiences of other communities were researched by means of a literature search, internet postings, and phone interviews with 28 other traffic engineering or planning departments.

II. PROGRAM OVERVIEW

Speed humps were first developed in the early 1970's at the Transport and Road Research Laboratory in Britain. Researchers studied the effects of various sizes and shapes of humps on vehicles moving at different speeds. The one found to be most appropriate for residential streets was a parabolic hump 12 feet wide, rising to a height of 3 or 4 inches. These studies were first published by C.K. Watts, and hence, the standard speed hump is often referred to as the "Watts Profile" hump. The speed *hump* must be distinguished from the speed *bump*, which is much more narrow and steep. Speed bumps are often found in private parking lots; they are not appropriate for public streets.

Speed humps first appeared on U.S. streets in the early 1980's. Berkeley installed its first speed humps on six streets in 1990 as part of a pilot program. The installations were intended to solve several problems. Two of the streets were affected by drug-related traffic, one had a high accident rate, two had general speeding problems, and one street (Milvia) was completely redesigned as a "slow street" involving a number of traffic calming measures. A 1991 evaluation of these installations by city staff found that the speed humps were working to reduce speeds, although some were working better than others.

No more speed humps were installed until late 1992, when six humps were installed on Derby Street between Shattuck and Dana. At that time, the City Council adopted rules governing the speed hump program, including street selection criteria and a system for ranking streets that meet the criteria. (Council Resolution 56,771 N.S.). The Speed Hump Criteria Worksheet (see Appendix A) identifies the specific engineering characteristics that must be met for any block to be considered for speed humps. One of these criteria is a petition signed by at least two-thirds of households on a block (see Appendix B).

Because demand for speed humps exceeded available funding, a point system was developed to rank requesting streets in order of priority (see Appendix C). The ranking system accounted for the amount of speeding on a street, the accident history, the proximity to schools, parks and institutions, the length of the block, and past attempts with alternative measures. Later, in 1995, this point system was revised to account for different street widths and for traffic volume (see Appendix D).

In July of 1993, Council authorized 45 street segments to receive speed humps as Special Enforcement Areas. (Council Resolution 57,099 N.S.) These Special Enforcement Areas were determined by the Police Department to have incidents such as drug selling, drive-by shootings or reckless driving that warranted speed humps. The speed humps were intended to be part of a combination of measures to improve the quality of life in certain neighborhoods. Because the problems were often considered urgent, these speed humps did not go through the normal screening procedure described above. Instead, a special criteria evaluation form was developed for Special Enforcement Areas (see Appendix E). Subsequent Council Resolutions (57,160 N.S.; 57,364 N.S.) added 13 more street sections to receive speed humps as Special Enforcement

Areas.

The bulk of the Special Enforcement Area speed humps, nearly 90 of them, were installed in March and April of 1994. Meanwhile, requests continued to arrive for speed humps through the normal process. Staff estimates that by mid-1994, about 140 blocks had submitted petitions to have speed humps installed, though not all of these blocks qualified for installation.

About this time, the City's Fire Department voiced greater concern about the speed hump program. Speed humps delay emergency response vehicles, and may cause damage to equipment or injure personnel unless the vehicles slow considerably. Berkeley already has an extensive system of traffic diverters that limit access to some streets. The Fire Department felt that the proliferation of speed humps was jeopardizing their primary mission of protecting the safety and property of Berkeley residents.

Also at this time, several Berkeley residents with special medical conditions voiced concerns about the problems that speed humps can cause to some members of the disabled community. In particular, residents with severe arthritis have indicated that driving or riding over speed humps, even slowly, can cause considerable pain.

In July of 1995, the Council approved the installation of speed humps on four high-priority streets from a list of 19 submitted, and then placed a moratorium on the speed hump program until a complete evaluation could be performed. Since that time, the only new speed humps installed were on Santa Fe Avenue, where a 22-foot wide, flat-top design was used as a demonstration project.

Currently, there are 156 speed humps in Berkeley on 99 blocks. For perspective, there are roughly 1,000 blocks in Berkeley, so about 10% of the blocks have speed humps. Most of the speed humps are concentrated in West Berkeley and in Southwest Berkeley. Roughly two-thirds have been installed as Special Enforcement Area projects; the remainder went through the normal process that requires a petition signed by at least 65% of residents. Appendix F lists the blocks with speeds humps, along with the date of installation. With the exception of those on Santa Fe Avenue, all speed humps in Berkeley are of the standard Watts profile design of 12 feet wide, 3 to 3½ inches high, and parabolic in shape. (See Appendix G for speed humps specifications.)

The cost to install, sign and mark a speed hump on a typical street is roughly $1,500. A program to install, say, 20 speed humps per year requires roughly $30,000 per year. Staff estimates that $200 to $300 per year per hump is appropriate to maintain the speed humps. It should be noted, however, that the true maintenance costs associated with speed hump is unknown, because no speed humps in Berkeley are more than seven years old. After a period of 10 to 15 years, the humps may deteriorate and require complete reinstallation. Resurfacing of a street requires removal of the speed humps and reconstruction.

III. RESIDENTS' OPINIONS

A mail survey of over 1000 households in Berkeley was conducted in order determine the opinions of residents regarding speed humps. Most speed hump surveys in other cities have questioned only residents living on streets with the devices. In order to receive a broader range of resident opinions as part of this evaluation, survey forms were sent to households both on streets with and without speed humps.

Survey Results

Results of the survey are described below. For certain questions, results have also been evaluated for subsets of the survey population, such as households with young children, longer-term residents and residents of certain areas of the City. A summary of the results is presented in Table 1; full survey results are included as Appendix H.

Do residents like speed humps?

Residents on blocks with speed humps clearly favor them. For the survey sample mailed to speed hump streets, only 17% of respondents indicated that they "dislike" the speed humps, while 67% "like them" and 12% had no opinion. Households with young children were even more supportive – 75% like them and 15% dislike them. When asked how they felt about the installation of speed humps on *other* blocks where residents want them, respondents were still in favor of the program – 57% support speed hump installation and 25% had no opinion, while only 13% are opposed.

For residents on streets without speed humps, a smaller portion supports the program. When asked how they felt about the installation of speed humps on *other* blocks where residents want them, 46% support speed hump installation, 29% oppose it, and 23% had no opinion. When asked if they would be interested in having a speed hump installed on their own block, 38% responded "Yes", 50% "No" and 11% "Maybe". Households in this group with young children were more interested in having speed humps installed – 54% responded "Yes" and 37% "No."

Effect on Traffic Speed

Nearly two-thirds of residents on speed hump streets perceive that speed humps have been effective at reducing speeds. Of the respondents, 65% felt that speeds had been reduced since hump installation, and another 15% said they didn't know. Longer-term residents are probably better able to determine the impact of speed humps. Of those living at the site for more than six years, 73% felt that speeds had been reduced. Residents on parallel streets without speed humps were divided about the effects on their own streets. Of this group, 23% felt that speeds had increased on their street, 17% felt that speeds had decreased, and 29% noticed no change.

Effect on Traffic Volume

The perceived effects of speed humps on traffic volume were less clear than the effects on

Table 1: Berkeley Resident Speed Hump Survey *Results Summary*

Dec 1996 - Jan 1997

	Blocks with Humps (n=366)	Blocks without Humps (n=342)	All Blocks (n=708)
How do you usually travel around Berkeley?			
Car	75%	75%	76%
Bicycle	4%	5%	4%
Walk	6%	4%	5%
Bus	3%	2%	3%
Other	-	-	-
(multiple or no response)	12%	14%	13%
When you travel around Berkeley, do you avoid streets with speed humps where possible?			
Yes, always	10%	16%	13%
Yes, sometimes	39%	44%	42%
No	47%	37%	43%
No Opinion	3%	1%	2%
(multiple or no response)	1%	2%	2%
Is there a speed hump directly in front of your house?			
Yes	54%	n.a.	
No	46%	n.a.	
(multiple or no response)	<1%		
Have you noticed a change in traffic speeds on your block since the speed humps were installed?		***(...on nearby blocks?)***	
Higher speeds	2%	23%	
Lower speeds	65%	17%	
No change	15%	29%	
Don't know	15%	21%	
(multiple or no response)	2%	10%	
Have you noticed a change in the number of vehicles driving on your block since the speed humps were installed?		***(...on nearby blocks?)***	
More vehicles	3%	27%	
Fewer vehicles	30%	7%	
No change	39%	31%	
Don't know	27%	28%	
(multiple or no response)	2%	8%	
Have you noticed a change in traffic noise on your block since the speed humps were installed?			
More noise	12%	n.a.	
Less noise	40%	n.a.	
No change	26%	n.a.	
Don't know	18%	n.a.	
(multiple or no response)	4%		
Speed humps delay fire trucks and ambulances responding to emergencies. More than one minute may be added to the average response time of four minutes. Do you feel this is reason for the city to avoid adding new speed humps?			
Yes	23%	42%	33%
No	48%	35%	42%
Not sure	26%	20%	23%
(multiple or no response)	3%	3%	3%

Table 1, Continued

	Blocks with Humps (n=366)	Blocks without Humps (n=342)	All Blocks (n=708)
Do you think the speed humps have had any effect on crime in your neighborhood?			
Increased crime	1%	2%	
Decreased crime	20%	11%	
No effect	30%	32%	
Don't know	45%	52%	
(multiple or no response)	4%	3%	
Do you experience pain or severe discomfort when driving over speed humps in Berkeley at the posted speed?			
Always	2%	5%	4%
Sometimes	14%	11%	13%
No	81%	82%	82%
(multiple or no response)	2%	2%	2%
Overall, how do you feel about the speed humps on your block?			
Like them	67%	n.a.	
Dislike them	18%	n.a.	
No opinion	12%	n.a.	
(multiple or no response)	4%		
Would you be interested in having speed humps on your block?			
Yes	n.a.	38%	
No	n.a.	50%	
Maybe	n.a.	11%	
(multiple or no response)		1%	
How would you feel about the installation of speed humps on other blocks if residents wanted them?			
Support new humps	57%	46%	52%
Oppose new humps	13%	29%	21%
No opinion	25%	23%	24%
(multiple or no response)	5%	2%	4%
How long have you lived on this block?			
Less than 1 year	6%	7%	6%
1 - 3 years	18%	16%	17%
4 - 6 years	10%	10%	10%
More than 6 years	64%	67%	66%
(multiple or no response)	1%	1%	1%
Are there any children in your household under the age of 13?			
Yes	29%	27%	28%
No	69%	71%	71%
(multiple or no response)	2%	2%	2%

Note: Percentages may not total 100 because of rounding.
1,063 surveys were mailed out, and 1,022 reached valid households. Of these, 708 (69%) were returned.

vehicle speed. On speed humps streets, 30% of residents felt that the humps resulted in fewer vehicles, but 39% noticed no change. On the parallel streets without speed humps, 27% felt that traffic had increased on their street with speed hump installation, 7% noticed a decrease, and 31% noticed no change.

Effect on Noise

Some residents have complained that speed humps have increased noise on their street. Yet only 12% of respondents on speed hump streets noticed an increase in noise; 41% felt that there was less noise, and 26% noticed no change. As expected, an increase in noise seems to be more noticeable for those living close to the humps. Of the residents who indicated that there was a speed hump directly in front of their house (about half the group), 17% noticed an increase in noise; those without a speed humps in front of their house, only 6% noticed an increase in noise. (Residents on streets without speed humps were not asked this question.)

Effect on Crime

Overall, most survey respondents felt that the installation of speed humps did not have any noticeable effect on crime in their neighborhood. On speed hump streets, 20% felt that crime had decreased since the installation, while 30% saw no effect on crime and 45% didn't know. Speed humps were installed explicitly to reduce crime only in the Special Enforcement Areas, and there is slightly a higher perception of success in these areas. On speed hump streets in the Special Enforcement Areas, 24% percent of respondents noticed a decrease in crime. As noted in Section VIII, however, speed humps were installed in Special Enforcement Areas as part of a multi-faceted effort to improve neighborhood safety, an effort that may have also included increased community policing, neighborhood watch groups, street clean-up and new lighting. It is difficult for anyone to attribute a crime reduction to the speed humps themselves.

Emergency Response Delays

Residents were asked if the possible delay to emergency response vehicles was reason to avoid adding new speed humps. Of all respondents, 33% felt that it *was* reason to avoid new speed humps, 42% felt that it was not, and 23% were not sure. Response from the two groups differed significantly, with residents on streets without speed humps more concerned about emergency response delay. Households with children were less concerned about emergency response delay.

Results to this question are difficult to interpret. The question indicates that "More than one minute may be added to the average response time of four minutes." While this may be true, it is a worst case scenario. If each speed hump delays fire trucks by about ten seconds (a conservative estimate), then only houses that require passing over six humps would experience delays of a minute or more. Most households would experience less delay in emergency response because of speed humps. The question requires that respondents weigh a possible decrease in safety due to emergency response delay with a possible increase in safety or quality of life due to slower traffic speeds, a comparison that is very difficult to make.

Pain or Discomfort at Speed Humps
All surveys contained the following question: "Do you experience pain or severe discomfort when driving over speed humps in Berkeley at the posted speed?" Of all respondents, 4% answered "Always", 13% answered "Sometimes", and 82% answered "No". This question is subject to varying interpretation and thus the response is difficult to interpret. The "posted speed" at speed humps is 15 mph. It may be that some thought this question was referring to the speed limit on the rest of the street – normally 25 mph – a speed at which many people would feel some discomfort on speed humps. Comments added by respondents indicate that some also feel that 15 mph is too fast for the City's humps. (See Section VII) But the response does suggest that the problem of residents with special medical conditions feeling pain at speed humps is not limited to just one or two persons.

As expected, residents who feel pain or discomfort at speed humps view the program less favorably, though they are not unanimously opposed to it. Of those who responded "Always" or "Sometimes" to this question, 41% are opposed to the installation of speed hump on other streets, 27% support it, and 30% gave no opinion.

Special Enforcement Area Differences
Given that about two-thirds of speed humps were installed in Special Enforcement Areas, a process that often did not require a resident petition, one might expect that residents in these areas might have views on speed humps that differ significantly from residents on streets that did petition for them. However, when the survey results are split into these two groups, the differences are quite small. Of the residents on speed humps streets in Special Enforcement Areas, 66% indicated that they "like" the speed humps on their street, and 58% support installation on other streets. For residents on speed hump streets in non-Special Enforcement Areas, 68% "like" the speed humps on their street and 56% support installation on other streets.

Survey Methodology

About 530 survey forms were mailed to households on streets with speed humps and another 530 to households on nearby streets without humps. It was felt that residents on speed humps streets are generally more supportive of the program than other residents in the City. This assumption was based in part on the results of a small preliminary resident survey conducted in 1995 (61 responses). The other half of the surveys were sent to residents living near, but not on, streets with speed humps. These residents may be forced to drive over the humps regularly, but may not gain the benefits of reduced vehicle speed and/or volume. These streets may even experience increased traffic due to diversion away from speed humps. It was assumed that these residents were generally less supportive of the speed hump program.

Sample Selection – Streets With Humps
Using a map of all speed hump locations in Berkeley, a database was created of all residences on blocks with at least one speed hump. The total number of addresses came to about 1,800. Five blocks were removed from the database because they had been involved in the preliminary

survey. Several additional blocks were also removed because of the presence of street closures or other traffic calming measures which disrupt normal traffic patterns. This left about 1,500 residential addresses. A random sample of about 530 households was chosen from this list to receive the survey.

Sample Selection – Streets Without Humps
To create a database of households on blocks without speed humps, a City map was consulted to identify blocks near speed humps which were likely to receive diverted traffic. Ideally, these blocks were parallel to the speed hump blocks, were a similar width, and carried similar traffic volumes. Arterial streets such as Sacramento, Adeline, Ashby and Shattuck were excluded. In some areas, namely southwest Berkeley, it is difficult to find unbarricaded parallel blocks without humps. In these areas, perpendicular street sections were chosen where necessary. The intention was to identify roughly one block without humps for every block with humps, so that the second database would have a similar number of households as the first. In the end, the final "no speed hump" database contained about 1,200 addresses. A random sample of about 530 households was chosen from this list to receive the survey.

The surveys sent to the two group differed slightly, though they were designed to be as similar as possible. Both are attached as Appendix I-1 and I-2. The survey sent to residents on streets with speed humps (I-1) has two more questions than the other survey – one question asks about the proximity of the speed humps to the house, and the other asks about the effects of the speed humps on noise. Except for some minor wording differences to accomodate the different audiences, the two surveys are otherwise identical.

In November of 1996, 1,063 surveys were mailed out, including a small pilot mailing. All surveys were given a number which was entered into the address database. Roughly 440 completed surveys had been returned by the end of the year, and 41 came back as undeliverable. In early January of 1997, a second copy of the survey was mailed out to those households that had not responded. This resulted in another 268 completed surveys returned. Thus, 708 completed surveys were returned out of 1,022 that reached valid households, giving an effective response rate of 69%.

Survey Significance
With the large number of survey responses, these results can be assumed to be statistically significant – a very good indicator of how the entire survey population would respond to such questions. This was not, however, a survey of all residents in the City of Berkeley. The survey tells us nothing about the opinions of residents who do not live near a speed hump. This survey has been designed to determine the opinions of residents living near speed humps on the assumption that these residents most acutely feel their effects, either good or bad, and will provide the full spectrum of opinions on speed humps.

If comparisons are to be drawn between the survey group living on streets with humps and the group living on steets without, then the groups should be comprised of households that are

similar demographically. This appears to be the case, based on the response to several control questions regarding primary mode of travel, length of stay at current residence and presence of young children. However, it cannot be assumed that the differences in the responses by the two groups are explained only by the presence or absence of speed humps. Despite efforts to select streets with similar characteristics, it is likely that speed humps streets generally had higher traffic volumes and speeds than non-speed humps streets (at least until the speed hump installation). Thus, those living on speed hump streets are more aware of the effects of motorized vehicles, and probably more supportive of traffic calming measures. Moreover, outside of the Special Enforcement Areas, two-thirds of residents on a block had to sign a petition to have speed humps installed. Because they were consulted and agreed to the installation, these residents probably feel more supportive of the program regardless of the effects of the speed humps.

Conclusion

Berkeley residents in speed hump areas clearly support the speed hump program. Of residents on streets with speed humps, 57% support the installation of more humps and 25% had no opinion. On streets without speed humps, 46% support the installation of more humps and 23% had no opinion. Residents feel that speed humps have generally been effective at reducing traffic speeds. They feel that speed humps have had much less impact on traffic volume, street noise and crime. Residents are concerned about the delay to emergency vehicles, though only 33% feel that this is reason to discontinue the program.

IV. IMPACT ON TRAFFIC SPEED

Speed humps are primarily designed to reduce high vehicle speeds on residential streets. It is therefore crucial to determine whether or not they have been effective in accomplishing this goal, and to what degree. To do this, studies must be done which record vehicle speeds both before and after speed hump installation. An evaluation of these studies done both in Berkeley and in other cities is included here.

Speed studies often determine both the average speed (the mean of all recorded speeds) and the 85th percentile speed (the speed exceeded by 15% of vehicles). The 85th percentile speed is used as a guide in determining the enforceable speed limit under California law. Since speed humps are designed primarily to influence speeders, as opposed to those traveling at low speeds, reducing the 85% percentile speed is the most important factor in the evaluations.

Because vehicle speeds vary along the length of a block, it is important to be consistent in terms of where on a block speed measurements are taken. In all the speed studies from Berkeley and from other cities evaluated here, before-installation speeds were measured mid-block; after-installation studies measure the highest speed attained between speed humps, or if a single hump exists, between the hump and an intersection.

Evidence from Berkeley

Speed humps have been installed on 99 blocks in Berkeley. Unfortunately, for most of the blocks, studies of speeds prior to installation are not available. The majority of speed humps in Berkeley were installed in Special Enforcement Areas, and procedures for these humps did not require measuring speeds before the installation. Data from before speed hump installation does exist for 15 blocks. Most of these streets are in North Berkeley. “Before” speed studies exist for only two blocks in southwest Berkeley, and for none of the streets west of San Pablo Avenue.

The data that does exist shows a clear pattern of speed reduction as a result of the speed hump installation. A summary of this data is presented in Table 2. Speeds have been measured both between the humps and on the humps. For the speeds between the humps (the maximum attainted by the vehicle on the block), the 85th percentile speed has been reduced by 5 to 11 mph. Before installation of the speed humps, 11 of the 15 streets had an 85th percentile speed of 30 mph or more; after installation, all were less than 30 mph. Speeds on the humps are predictably much lower – the 85th percentile speed measured here ranges from 12 to 18 mph.

Also presented in the table is the range of speeds before and after installation. Often the perceived problem with speeders comes from a small fraction of vehicles that grossly flaunts the speed limit. Reducing speeds for this fraction is critical to making streets feel safer. Of the 15 streets studied in Berkeley, the highest recorded speeds before hump installation ranged from 28 to 48 mph, and on nine streets the highest speeds were at or over 35 mph. After installation, the highest recorded speeds range from 22 to 33 mph, and 12 of the 15 streets had top speeds under

Table 2: Effects of Speed Humps on Vehicle Speed -- Berkeley

		Before Hump Installation (in mph)			After Hump Installation (in mph)					
					Between Humps			On Hump(s)		
Street	Cross Streets	Avg Speed	85% Speed	Range (Lo/Hi)	Avg Speed	85% Speed	Range (Lo/Hi)	Avg Speed	85% Speed	Range (Lo/Hi)
Acton St.	Addison to Allston	26.0	29	18/35	17.1	22	11/25	9.2	13	5/14
Berkeley Way	Chestnut to Acton	27.5	31	21/35	18.0	22	11/30	10.4	13	5/18
Bonar St.	Allston to Bancroft	27.7	32	21/35	18.0	21	9/22	9.4	12	4/20
Capistrano Ave.	Colusa to The Alameda	29.3	32	16/38	19.5	24	13/26	11.1	14	6/20
Catalina Ave.	Colusa to The Alameda	20.9	25	12/29	18.4	22	13/26	12.7	17	5/21
Cornell Ave.	Gilman to City Limits	27.5	30	21/34	22.0	25	14/26	11.1	13	8/16
Curtis St.	Gilman to Hopkins	32.1	34	22/37	22.4	28	17/28	12.3	16	7/20
Derby St.	Mabel to Acton	27.9	31	20/40	19.6	22	14/26	11.1	13	7/20
El Camino Real	Domingo to The Upland	23.6	28	17/30	19.1	23	12/27	11.5	15	6/24
Masonic Ave.	Gilman to City Limits	25.5	30	17/37	20.5	24	15/25	10.1	14	5/17
Oxford St.	Eunice to Rose	28.8	33	18/41	23.1	26	19/33	11.8	15	7/20
Peralta Ave.	Gilman to City Limits	31.7	36	19/48	22.0	25	15/28	12.4	17	7/23
Santa Fe Ave.*	Gilman to Camelia	26.5	31	19/33	21.7	25	15/29	14.4	18	8/25
Tacoma Ave.	Colusa to The Alameda	27.3	33	20/34	23.8	27	19/31	12.9	17	6/21
Tyler St.	Sacramento to Californi	23.0	26	15/28	17.6	20	13/24	10.7	14	5/19

* Santa Fe speed humps are 22 ft wide, flat on top.

30 mph.

The City has collected after-installation speed data for a large number of the blocks with speed humps. While the extent of speed reduction cannot be determined for these, it is significant that most of the streets now have an 85th percentile speed that is at or below the speed limit. Of the 53 blocks measured, only eight had an 85th percentile speed over 25 mph, and none had an 85th percentile speed over 30 mph.

Evidence from Other Cities

Although the "before and after" speed studies were done on only 15 streets in Berkeley, the results are supported by a number of studies in other cities. As part of this evaluation, staff contacted traffic engineering departments in other cities known to have experience with speed humps, and many have sent results from their own speed hump program evaluations. While some of these cities may be significantly different from Berkeley in terms of age, traffic levels, street width, etc., the effects of speed humps seem to be similar in nearly all cases.

The speed studies collected by staff evaluated a total of 115 street segments in 11 American cities and the United Kingdom. For the purpose of presentation, the speeds on the segments measured were averaged for each city. Thus, the "mean" 85th percentile speed for a given city is not a true average of all vehicles, as streets with low volumes carry the same weight as those with high volumes. But the results serve to illustrate the magnitude of the change. A summary of the results is presented in Table 3.

On all segments, the installation of speed humps led to reduced speeds, including speeds between the humps. The average 85th percentile speed decreased in the range of 4 to 11 mph, with most cities finding a decrease of around 8 mph. Many cities show greater speed reductions than Berkeley, most likely because the "before" speeds are substantially higher than in Berkeley. In general, the greatest speed reduction occurs when pre-hump speeds are highest.

Speed Hump Spacing

Vehicle speeds will always be lower directly on the speed hump than midway between humps. Some speed hump critics have claimed that drivers race between humps, resulting in overall speeds that are no lower than without the speed humps. All studies presented here have measured speeds between humps, and show that this is clearly not the rule. However, the spacing of speed humps is critical in reducing speeds between them. Cities have found that in general, closely-spaced speed humps (150 to 400 feet) result in greater speed reduction. In some cities studied, speed humps were placed much farther apart, and the resulting decrease in speed is not nearly as great. In Phoenix, where the speed humps are as much as 900 feet apart, there may

Table 3: Effects of Speed Humps on Vehicle Speed -- Studies in Other Cities

Location		Number of Segments Evaluated	Mean of All Segments Evaluated (in mph) Before Humps	After Humps	Change
Austin, TX	(12 ft humps)	11	85% speed = 37	85% speed = 29	- 8
	(22 ft humps)	2	85% speed = 37	85% speed = 29	- 8
Beverly Hills, CA	(1-hump blocks)	10	avg speed = 37	avg speed = 32	- 5
	(2-hump blocks)	9	avg speed = 34	avg speed = 29	- 5
Howard County, MD	(12 ft humps)	5	85% speed = 39	85% speed = 29	- 10
	(22 ft hump)	1	85% speed = 41	85% speed = 30	-11
Los Angeles, CA		15	n/a	n/a	-17 to -1
Montgomery County, MD		5	85% speed = 36	85% speed = 27	- 9
Oakland, CA		14	85% speed = 32	85% speed = 25	- 7
Pasadena, CA		12	avg speed = 32	avg speed = 25	- 7
Pheonix, AZ		4	85% speed = 33	85% speed = 30	- 3
Portland, OR		5	85% speed = 34	85% speed = 27	- 7
Thousand Oaks, CA		11	85% speed = 36	85% speed = 26	- 10
United Kingdom	(4" humps)	8	85% speed = 32	85% speed = 22	- 10
	(3" hump)	1	85% speed = 37	85% speed = 26	-11
Walnut Creek, CA		2	85% speed = 36	85% speed = 31	- 5

Note: All speeds were measured between humps.
Humps are 12' wide, 3" high unless otherwise noted.

be almost no reduction in speed midway between the humps.[1]

Speeds Over Time

Most speed hump studies measure speeds fairly soon after the installation in order to determine the effects. In some instances, it may be that drivers become used to the speed humps over time and begin to drive over them at higher speeds. Several cities have attempted to address this question by measuring speeds several times after hump installation. In Walnut Creek, speeds on two streets were measured after hump installation and then twice more, after one year and again after 18 months. In both cases, the 85th percentile speed increased only slightly over time, by roughly 1 mph. Austin, Texas also measured the 85th percentile speed on six speed hump streets after installation, and again after a lag time. The results show either no change in the 85th percentile speed, or an increase of only 1 or 2 mph.[2] The Institute of Transportation Engineers "Proposed Recommended Practice " for speed humps supports these findings, stating, "speed and volume modifications caused by humps tend to remain constant over time."[3]

Speed Tables

A number of communities, including Berkeley, have experimented with wider, 22-foot speed humps, sometimes called "speed tables." These humps are the same height as the 12-foot humps, but have a 10-foot flat section in the middle. They are designed to cause less vertical displacement to vehicles traveling over them and thus, generally allow higher vehicle speeds. Passenger vehicles can travel over the 22-foot humps comfortably at up to 25 mph, while the 12-foot humps generally require speeds no higher than 15 mph. The wider speed humps may not reduce mid-block speeds to the extent that 12-foot humps will.

In Berkeley, two 22-foot speed humps have been installed on Santa Fe Avenue. Speed data taken before and after the installation shows that these humps have effects that are similar to the 12-foot humps. The 85th percentile mid-block speed was reduced from 31 mph to 25 mph. Measurements taken on the humps show somewhat higher speeds than on the 12-foot humps – the average speed on the wide humps was 14.4 mph, compared to about 11 mph on the regular ones.

Seminole County, Florida was among the first U.S. cities to install wider speed humps. On one street they evaluated, the portion of vehicles traveling over 35 mph fell from 35% to 7% with the

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[1] City of Phoenix, Arizona, "Experimental Tests with Speed Humps in Phoenix, Final Report," Department of Streets and Traffic, January 1986.

[2] City of Austin, Texas, "Summary of Pilot Humps Results," Transportation Division, City of Austin, May 1995.

[3] "Guidelines for the Design and Application of Speed Humps: A Proposed Recommended Practice," ITE Technical Council Speed Humps Task Force, March 1993.

installation of 22-foot speed humps.[4] Howard County, Maryland found that wide humps reduced 85th percentile speeds from 41 mph to 30 mph on one street.[5] On the humps, speeds were only slightly lower, showing that wider speed humps result in a more uniform speed profile on the street, with less acceleration and deceleration. Austin, Texas also tested two blocks with 22-foot speed humps. Like Berkeley, they found that speed reductions were quite similar to that with 12-foot humps, though the sample size was also quite small.[6]

Thus, it appears that the 22-foot speed humps are performing well in reducing mid-block speeds while causing less disruption to drivers. The evidence from Santa Fe Avenue must be interpreted with caution, however. The speed humps are relatively new (installed in January 1996) and it may be that as drivers become used to the less punishing design, speeds on the street will increase. The first set of measurements were taken about three months after installation; measurements taken 18 months after installation continue to show no significant increase in speeds. The wide speed humps are also unique in Berkeley, which probably contributes to their slowing effects. Drivers used to the 12-foot humps may slow to 15 mph or less out of habit, not realizing that they could be moving faster. If 22-foot speed humps became more common in the City, it seems likely that they would have less of a slowing effect.

Conclusion

Studies in Berkeley and in other cities show that speed humps are extremely effective at reducing traffic speeds, particularly the highest speeds that are most troubling to residents. Properly spaced speed humps reduce traffic speeds both at the humps and between the humps, and speeds have not crept back up over time. Evidence from the use of wider, 22-foot speed humps is limited, but suggests that they can be nearly as effective as the standard humps in some situations.

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[4] Nicodermus, David, "Safe and Effective Roadway Humps: The Seminole County Experience," *ITE Compendium of Technical Papers*. 1991.

[5] Walter, C. Edward, "Suburban Residential Traffic Calming," *ITE Journal*. Vol. 55, No. 9, September 1995.

[6] City of Austin, Texas.

V. IMPACT ON TRAFFIC VOLUME

Speed humps may act to reduce the volume of traffic on a street in addition to speed. Vehicle trips do not simply disappear, of course, but drivers who do not have a destination on a particular block may choose an alternate route to avoid the speed humps. This is usually a desirable consequence for residents of the block, many of whom seek relief not only from excessive vehicle speeds but also from what they feel is excessive traffic. If vehicles are merely using the street as a bypass to avoid more congested arterials, then some diversion caused by the speed humps is acceptable, and probably desirable.

Speed humps are not, however, intended to close off a block to all but the abutting residents. If a significant amount of diverted traffic ends up on a parallel local street, then the speed humps may adversely impact the quality of life for residents on that street. The grid pattern of streets in Berkeley increases the likelihood of this kind of diversion. It is important, then, to determine how much, and under what circumstances, traffic diversion occurs as a result of speed humps.

Evidence from Berkeley

Unfortunately, the City of Berkeley does not have reliable records of traffic volumes on most streets before and after speed hump installation. Two streets have been evaluated – Milvia and Derby north of Shattuck. On Milvia, the 1990 "slow street" project included the installation of a variety of traffic calming measures, including speed humps, chicanes, lane-narrowing striping and textured paving. The result was roughly a 20% decrease in traffic volume. It is not possible to determine the portion of this attributable to the speed humps alone.

Traffic on Derby Street has been cut in half by the installation of speed humps, falling from 3,600 vehicles per day to about 1,800. This has significantly altered the circulation patterns in the neighborhood. Of the eight residential streets between Dwight and Ashby, Derby formerly carried the highest volume of traffic. Now, three other streets carry higher volumes than Derby, with Parker and Carleton receiving much of the diverted traffic. The impact of the Derby Street speed humps is one of the most extreme cases in the City. Traffic engineering staff estimates that diversion away from speed hump streets has been lower in most other cases.

Evidence from Other Cities

Reports from eleven other cities describe traffic volume studies before and after speed hump installation. A summary of the results are presented in Table 4. In general, cities have found that installing speed humps does reduce traffic volume on the street, though not always. Whether the diverted traffic ends up on parallel local streets depends entirely on the particular conditions – in some cases, parallel streets have actually seen a reduction in traffic volume. It is also important to note that many factors can affect traffic volume, including new commercial development, intensification of land use, the timing of nearby traffic signals, or even the season. Studies do not always control for these factors, and therefore it is difficult to make any definitive conclusions

Table 4: Effects of Speed Humps on Traffic Volume -- Studies in Other Cities

Location	Number of Segments Evaluated	Effect of Speed Hump Installation (on average daily traffic, or adt)
Austin, TX	10	6 had lower adt, 4 had higher adt, range -36% to +13% on 5 parallel streets, 4 had no signif. change, 1 had 45% higher adt
Beverly Hills, CA	19	average change is -7% adt
Howard County, MD	5	no significant change in volume
Los Angeles, CA	14	10 had lower adt, 4 had higher adt adt decreases where alternate route exists
Oakland, CA	14	7 sites: over 10% decrease in adt 6 sites: no sig. change in adt (-10% to +10%) 1 site: over 10% increase in adt
Pasadena, CA	12	all lower adt, range - 17% to - 60% On pairs of parallel streets: 3 of 12, both increase vol 4 of 12, both decrease vol 5 of 12, one increase, one decrease vol
Phoenix, AZ	8	5 had lower adt, 3 had higher adt, range -11% to +15% at 2 control sites (expected to get diverted traffic), adt -10% and +32%
Portland, OR	5	all lower adt, range - 21% to - 32% on parallel route expected to get diversion, no change in adt
Thousand Oaks, CA	5	all lower adt, range - 21% to - 53%
Toronto, ON	6	marginal decrease in volume
Walnut Creek, CA	2	one had -14% adt, other had +1% adt

from these reports. Even if external factors are controlled for, normal traffic flow variations may cause fluctuations of up to plus-or-minus 10 percent.

Pasadena has performed one of the more comprehensive studies of the effects of speed humps on traffic volumes.[7] For 12 streets with speed humps, average daily traffic (ADT) was measured before and after installation on the speed hump street and on both parallel streets. They found that all streets with speed humps experienced a reduction in ADT, ranging from 17% to 60%. On parallel streets, the effects were decidedly mixed. For three of the cases, both parallel streets saw increased ADT; for four of the 12, both parallel streets saw decreased ADT; for the remaining five, ADT increased on one parallel street and decreased on the other.

Austin, Texas has studied traffic volume changes on 12 street segments with speed humps, and on five parallel routes.[8] On eight of the 12 segments, daily traffic decreased, while on the other four, daily traffic increased. The changes ranged from -36% to +13%. Volumes on the parallel streets were largely unchanged, except for one parallel street which had a 45% increase in ADT.

Implications

Reducing traffic volume is not the primary intent of speed humps. Some reduction is probably inevitable and acceptable, particularly if diverted vehicles were formerly using a residential street to bypass congested arterial streets. When speed humps divert a significant amount of traffic to other local residential streets, the impact can be significant and potentially unacceptable. Parallel local streets seem to suffer most when they offer an equally convenient route for through traffic. This seems to be the case with Derby Street, where parallel streets to both the north and south are similar residential streets that provide a link between the major arterials of Shattuck and Telegraph. On Milvia Street, the parallel streets are both busy major arterials (Shattuck and Martin Luther King). Traffic reductions have been lower here, despite traffic calming measures that are equivalent to or more intense than those on Derby, most likely because the parallel routes are less attractive alternatives.

As discussed in the Recommendations (Section XIV), this study recommends that the City establish a threshold for an acceptable level of traffic diversion. It is important for the City to estimate the magnitude of diverted traffic before installation, and to monitor traffic volumes afterwards. In general, the traffic reduction on Milvia is perceived as more acceptable than that on Derby. The speed humps on Milvia have caused less diverted traffic, and most of the diversion likely goes to major arterial streets rather than local streets.

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[7] City of Pasadena, California, "Evaluation of the City of Pasadena Speed Hump Program," prepared by the Public Works and Transportation Department, City of Pasadena, April 1991.

[8] City of Austin, Texas.

Conclusion

The studies done in Berkeley and other cities indicate that speed humps generally decrease traffic volume on the street where they are installed, and have the potential to divert a significant amount of the traffic to other local streets. If a parallel local street is equally convenient to through traffic, it is likely that it will receive diverted traffic. Traffic diversion of this nature can have a significant impact on surrounding residential streets.

VI. IMPACT ON EMERGENCY SERVICES

Speed humps can impact fire, ambulance and police vehicles responding to emergencies. Berkeley is committed to providing its residents with high-quality public safety and the City must continually evaluate whether speed humps or any traffic calming devices are compromising this commitment.

Fire Department / Ambulance

The Berkeley Fire Department (BFD) has voiced several concerns with the speed hump program, and is generally opposed to any further use of the devices. These concerns are:

- Speed humps slow fire department vehicles responding to emergencies. Large, heavy vehicles like fire engines are generally slowed more than smaller passenger vehicles.
- Speed humps may cause damage to fire vehicles.
- Speed humps can make it difficult to transport injured persons in ambulances.

The City has seven fire stations, each of which has an engine company consisting of three firefighters and a fire engine. The two downtown stations (at Shattuck & Berkeley Way and at Shattuck & Derby Street) also have a ladder truck and an additional company . The City provides its own ambulance service, using three ambulances which are based at the two downtown fire stations and at the 8th & Dwight station.

Emergency calls to the BFD are identified as either medical or fire emergencies. The BFD responds to all medical calls with an ambulance and a fire engine, or with a ladder truck if no engine is available. Emergency calls that are identified as potential fires are responded to with a minimum of three vehicles, including an ambulance, fire engine and ladder truck. If all of Berkeley's ambulances are out of service or occupied, the City has mutual aid agreements with several neighboring providers, including Albany, Piedmont, and American Medical Response (Oakland's provider).

Because the fire engines in Berkeley are more numerous than ambulances and more widely dispersed, they are usually the "first responder" on the scene of an emergency. All engine companies include Emergency Medical Technicians (EMTs), and they are often the ones performing critical life-saving procedures. For example, in many cities including Berkeley, fire engines now carry automatic cardiac defibrillators to use on heart attack victims. The delay caused by speed humps is therefore probably most critical for fire engines.

Measurements of Delay

In order to determine the delay caused by speed humps, tests were conducted using Berkeley Fire Department staff and vehicles. Two tests were performed, one on the regular speed humps on Derby Street and one on the wider humps on Santa Fe Avenue. For each test, a fire engine and ladder truck were driven over the blocks with speed humps and then over a similar blocks without humps. Each run was timed, and the difference in time is attributed to the delay caused

by speed humps.

For the regular speed humps, the test results are summarized in Table 5. Tests were performed on three blocks of Derby Street and on the parallel blocks of Carleton Street. Each block is roughly 600 feet long and on Derby Street, each has two speed humps spaced 200 feet apart. Both streets are 36 feet wide. Vehicles were run "Code 3" in the test, as if responding to an actual emergency. The tests suggest that a block with two 12-foot speed humps adds roughly 20 seconds of delay to emergency response time, or about 10 seconds per hump. The delay is similar for the engine and ladder truck.

Table 5: Delay to Fire Department Vehicles, Standard 12-Foot Speed Humps

	Fire Engine				Ladder Truck		
	Derby St. (humps)	Carleton St. (no humps)	Delay		Derby (humps)	Carleton (no humps)	Delay
Block 1	40 sec	19 sec	21 sec	Block 1	40 sec	20 sec	20 sec
Block 2	40 sec	18 sec	22 sec	Block 2	43 sec	24 sec	19 sec
Block 3	40 sec	19 sec	21 sec	Block 3	39 sec	23 sec	16 sec
Total	120 sec	56 sec	64 sec	Total	122 sec	67 sec	55 sec

Note: 2 speed humps per block; all runs eastbound (slight grade up).
All 6 blocks approx. 600 feet long, 36 feet wide; humps are 200 feet apart.

For the wider, 22-foot speed humps, test results are summarized in Table 6. Tests were performed on a 700-foot block of Santa Fe Avenue and on a section of Evelyn Avenue of equal length. Santa Fe Avenue has two wide speed humps spaced 330 feet apart. Both streets are 30 feet wide. The tests suggest that the wider speed humps cause significantly less delay for the fire engine – two wide humps on a block added only 6 seconds of time, or about three seconds per hump. However, the delay for the ladder truck was similar to the delay caused by the 12-foot humps, with 27 seconds added over the whole block.

Table 6: Delay to Fire Department Vehicles, Wider 22-Foot Speed Humps

	Fire Engine				Ladder Truck		
	Santa Fe Ave (humps)	Evelyn Ave (no humps)	Delay		Santa Fe Ave (humps)	Evelyn Ave (no humps)	Delay
Total	35 sec	29 sec	6 sec	Total	50 sec	23 sec	27 sec

Note: 2 wide speed humps per block; all runs southbound (no grade).
Both blocks approx. 700 feet long, 30 feet wide; humps are 330 feet apart.

These tests should be used only as a rough estimate of speed hump impacts. Only one driver and vehicle was used for each test situation, and each driver reacts differently to speed humps. The

ladder truck driver on Santa Fe Avenue, for example, crossed the humps very cautiously and hence, the delay in this case was even greater than it was for the 12-foot humps. Based on anecdotal evidence from BFD staff, it seems likely that repeated tests with multiple drivers would show that 22-foot speed humps actually cause less delay for both types of vehicles.

Evidence from Other Cities

As part of this evaluation, informal telephone interviews were conducted with 28 other cities currently using speed humps. In most of the cities contacted (roughly 80%), there has been some concern expressed by fire or ambulance services over the use of speed humps. In some cities, speed humps continue to be installed over fire department objections. In others, various policies have been established which at least partially accommodate fire department concerns. A number of cities won't install humps on designated emergency routes, for example. In some other cases, the fire department has veto power over any location proposed for humps.

Several other cities have also tested the delay caused by speed humps. Portland, Oregon has conducted tests using fire engines, fire trucks, and ambulances in order to estimate the delay caused by a speed hump for various levels of desirable travel speed.[9] The results are presented in Table 7. They show that if the desirable travel speed is 25 mph, each speed hump causes about three to four seconds of delay for a fire engine or ladder truck. If the desirable speed is 40 mph, a speed hump will add an additional eight to ten seconds to the response time.

Table 7: Tests of Emergency Response Delay in Portland, Oregon

Vehicle	Desirable Speed	Delay per Speed Hump
Ambulance	at 25 mph	1.3 seconds
	at 40 mph	5.1 seconds
Fire Engine	at 25 mph	2.8 seconds
	at 40 mph	8.5 seconds
Ladder Truck	at 25 mph	4.3 seconds
	at 40 mph	10.3 seconds

Walnut Creek has compared the travel times for fire department vehicles before and after the installation of speed humps on one street. They found that travel times increased with the installation by about five seconds per hump. Boulder, Colorado reached a similar conclusion:

[9] City of Portland, Oregon, "The Influence of Traffic Calming Devices on Fire Vehicle Travel Times," Bureau of Fire, Rescue and Emergency Service and Bureau of Traffic Management, January 1996.

each speed hump caused four to six seconds in emergency response delay.[10] Thus, the speed hump delay measured in other cities is less than the delay found in Berkeley.

Emergency Response Times

One of the Fire Department's performance goals is to maintain an average response time of 4 minutes. The BFD generally meets its goal of a 4-minute average response time, though records from recent years indicate response times creeping up, as shown below. Nearly all speed humps were installed before FY 94/95, when the BFD began collecting response time data, and so it is difficult to determine if the average response time has been affected by the speed hump program.

Fiscal Year	BFD Average Response Time
94/95	3 min, 55 sec
95/96	4 min, 9 sec
96/97	4 min, 33 sec

The reasons for the recent increase in response time are not entirely known. Increased traffic congestion probably accounts for part of the rise. It may also be partially due to a more cautious approach to emergency response and more strict adherence to traffic laws because of the potential for accident liability.[11] [12]

Berkeley's goal of a 4 minute average response time is lower than several other Bay Area cities. In Oakland, response time records are not entirely accurate, but the average is between 5 minutes and 5 minutes 45 seconds. Menlo Park has an informal response time goal of 5 minutes. In Richmond, the goal is to make 85% of responses within 6 minutes, and their current performance is near this level. Of the few Bay Area cities contacted, San Francisco is the only one with a shorter response time goal – 3 minutes. They meet this goal largely because of a dense network of 41 stations across the city. Response time goals for selected cities outside California are listed below. All of these cities have speed humps.[13]

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[10] City of Boulder, Colorado, "Neighborhood Traffic Mitigation Program (NTMP): A Status Report," from Boulder City Council meeting, April 8, 1997.

[11] Hunt, R.C., L.H. Brown, E.S. Cabinum, et al, "Is Ambulance Transport Time With Lights and Siren Faster Than That Without?" *Annals of Emergency Medicine.* Vol. 25, No. 4, April 1995.

[12] Lacher, Mary E. And Judith C. Bausher, "Lights and Siren in Pediatric 911 Ambulance Transports: Are They Being Misused?" *Annals of Emergency Medicine.* Vol. 29, No. 2, February 1995.

[13] Greenwald, Jonathan and Mark Fearer, "Traffic Mitigation and Its Impact on Emergency Response Time," unpublished, City of Boulder Transportation Department, February, 1997

City	Response Time Goal
Austin, TX	4 min
Boulder, CO	6 min
Omaha, NE	4.8 min
Portland, OR	4 min
Seattle, WA	3-5 min

Implications of Delay

If each speed hump can add up to 10 seconds of delay, the question then becomes how prevalent and how significant is this delay. Currently, the fire department can reach nearly all structures in Berkeley by traveling over no more than two speed humps, so the maximum added delay is about 20 seconds. A few blocks in west and southwest Berkeley may require traversing four humps, adding up to 40 seconds. Thus, the time for a typical response could be increased by about 8%, and in some areas, 16%, by speed humps. This could obviously change with the installation of more speed humps. It is important to note that delay can also increase the likelihood that emergency response vehicles take an alternate, longer route to avoid the humps.

The BFD responds to roughly 10,000 to 12,000 calls each year. Approximately half of these are medical calls. For many calls, the addition of 20 or 40 seconds to the response time would make no difference in the outcome of the situation. For some calls, however, time is a critical factor. Studies by the National Fire Protection Association have shown that an entire room can become engulfed in flame within two minutes from the time of ignition. For some medical conditions, rapid response can be the difference between life and death. For example, a heart attack victim is often first treated with automatic defibrillation by fire engine EMTs, then with advanced cardiac life support (ACLS) by ambulance paramedics. Researchers creating a model to predict the survival rate of heart attack victims found that every minute of delay before defibrillation decreased the rate of survival by 1.1%, and every minute before ACLS decreased the rate of survival by 2.1%.[14] Clearly, a systematic increase in emergency response time for a community would the lower the chances of survival for these types of victims.

While several communities have measured speed humps delay, there have not been any studies which assess the impact of traffic calming devices on public safety in general. In Berkeley, emergency calls are classified only by the type of emergency and nature of the response. For example, in the first half of 1997, the BFD received 3,754 emergency medical calls. Of these calls, 45% required transporting a patient using Avanced Life Support (ALS), and 6% required Code 3 transport (running with lights and sirens). Fire Department data in Berkeley does not provide enough detail to pinpoint the impact of 20 or 40 seconds of delay on a particular

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[14] Larsen, Mary P., Mickey S. Eisenburg, Richard O. Cummins and Alfred P. Hallstrom, "Predicting Survival From Out-of-Hospital Cardiac Arrest: A Graphic Model," *Annals of Emergency Medicine.* Vol. 22, No. 11, Nov. 1993.

emergency situation. In general, the lack of data and studies on the impact of traffic calming devices makes it quite difficult to determine the impact of delay on emergency services.

Damage to Vehicles
In addition to delay, the Berkeley Fire Department is also concerned that speed humps can cause damage to their engines, ladder trucks and ambulances. New fire engines cost hundreds of thousands of dollars, and even minor repairs can be quite expensive. Speed humps can cause large vehicle frames to flex awkwardly, and the BFD suspects that repeated exposure to speed humps may be partially responsible for stress damage to their vehicles. In one incident, a fire department vehicle encountered new speed humps at night before the BFD was notified of the installation and before striping and signs were added. The vehicle crossed the humps at a high speed, reportedly damaging it and injuring a staff member when his head hit the cab ceiling.

In contacts with other cities using speed humps, there were no known cases of speed humps causing damage to emergency response vehicles. However, vehicle damage is a concern of many fire departments. In Sacramento, for example, the fire department is concerned primarily about vehicle damage, not response delay.

Berkeley roads present numerous obstacles to fire vehicles in addition to speed humps, including potholes, valley gutters (street drainage dips), and tight curves with curbs. It is difficult to document damage caused only by speed humps. Aware of the potential for damage, BFD drivers now seem to be using extreme caution when encountering speed humps. They face a trade-off between a higher potential for vehicle damage and a longer response time.

Ambulance Services
Speed humps also slow Berkeley's ambulances when responding to medical emergencies. Because there are fewer ambulances in the City, they generally travel longer in response to a call, and have a longer response time goal. Their current goal is to maintain an average response time of 5 minutes or less. In addition, Alameda County requires that the maximum response time of any ambulance not exceed 10 minutes. Any incident of response time greater than this may be reviewed by the County. Berkeley maintains as its own internal policy a maximum time of 8 minutes. The City has been fairly successful at achieving its average response time goal, as the recent figures below indicate:

Fiscal Year	Ambulance Avg. Response Time	Number of Calls
94/95	4 min, 55 sec	5350
95/96	5 min, 6 sec	4868

Ambulance service staff have said that their average response time has remained quite stable at just under 5 minutes for at least the past eight years. There is no evidence of an increase in average ambulance response time due to speed humps. It is interesting to note that the number of ambulance calls has been dropping in recent years, due in part to the cost-saving influence of

health care reform. For example, there were 587 medical emergency calls in January 1994 and only 393 in January 1997.

No tests were performed in Berkeley to measure the delay to ambulances caused by speed humps. Tests in Portland suggest that the delay to ambulances is significantly less than for fire engines and trucks. Ambulances are often not the first to arrive at an emergency, however, and a more important issue may be the impact of speed humps when injured victims are being transported to a hospital. Injured patients may experience pain when jostled, and paramedics may have difficulty performing medical procedures (like inserting an IV) on speed humps streets. Again, these factors have not been systematically tested in Berkeley. Planning staff have taken trial runs with Berkeley's ambulance service, crossing humps at various speeds. These informal tests indicate that the vehicles are able to cross speed humps at 15 mph without patients, but must slow down to 5 or 10 mph when transporting injured persons. The City of Thousand Oaks used an orthopedic surgeon strapped-down in an ambulance to evaluate speed hump impacts.[15] They found that crossing standard humps at 15 mph was acceptable, while crossing at 20 mph caused too much jostling for an injured patient.

Response Routes

The policy of the current speed hump program has been to avoid adding speed humps to designated Fire Response Routes. These routes were identified over 25 years ago. (See Appendix J for a map of these routes.) Since that time, a large system of diverters has been added to City streets and congestion has increased significantly. The Fire Department now must use alternate routes if designated Response Routes are congested. They have stated that keeping speed humps only off these routes is no longer sufficient, and have proposed a new classification system which identifies primary, secondary and tertiary response routes. This proposal is discussed in greater detail in the Recommendations Section.

Police Department

Speed humps can also have an impact on the Police Department by lengthening response times, slowing patrol cars in a chase, or potentially causing damage to police vehicles.

Response Time

Berkeley Police have not performed any systematic tests to measure the delay caused by speed humps. They do record the response time for calls designated as "Priority 1", which are the highest priority, time-critical calls. The goal of the department is to respond to 90% of these calls within five minutes. Police Department staff indicate that this goal is generally met – current figures are shown below:

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[15] City of Thousand Oaks, California, "Speed Humps and the Thousand Oaks Experience," J. P. Clement, Department of Public Works, September 1982.

Fiscal Year	Police Avg. Response Time
94/95	5 min, 3 sec
95/96	5 min, 4 sec
96/97	5 min, 21 sec

Like fire and ambulance services, the Police Department does not maintain response time records that go back to years before speed humps. Staff members have indicated that they do not recall any significant change in response time over the last 10 years, and there is no general feeling within the Police Department that response times are increasing.

Chase Situations

The Police occasionally chase a suspect, and speed humps could have an impact in these situations. Police patrol cars, particularly newer ones, can drive over speed humps at a higher speed than most other vehicles. Police staff have indicated that new patrol cars can maintain speeds of up to 25 mph over the humps. In this way, speed humps might give the police an advantage when chasing another vehicle. However, the Police Department is placing greater emphasis on fleet management and minimizing the expenses due to police vehicle damage. Police officers will likely drive more slowly over speed humps in non-life threatening situations. The combination of these conflicting factors means that on the whole, speed humps probably have little impact on chase situations. The Police Department has also adopted a policy to minimize the chasing of suspects because of the potential for liability in cases of accidents.

Damage to Vehicles

Speed humps could damage police cars if officers hit them unexpectedly or are forced to drive over them at high speeds. The Police fleet manager does not know of any instances of speed humps causing damage to police vehicles, aside from minor scrapes. Most vehicle damage of this sort comes from curbs when officers make quick U-turns. It has been suggested that speed humps increase the normal wear and tear on police vehicles, though there is no documentation of this. Nor are there any known cases of speed humps causing injury to police staff.

Conclusion

Speed humps can cause significant delay to Fire Department vehicles. Records from the Fire Department are not extensive enough to determine if speed humps have directly led to an increase in average response time. However, tests show that fire vehicles driving on a typical block with speed humps can experience a delay of up to 10 seconds per hump. Passing over several of these blocks would add considerably to the average response time goal of 4 minutes. Emergency vehicles that do not slow down sufficiently at speed humps could suffer expensive damage. Because of the delay they cause, speed humps can increase the risk that residents will suffer from fire damage, injury or even death. At this time, it is not possible to accurately estimate the level of this additional risk. Speed humps have less impact on Police Department operations.

VII. IMPACT ON DISABLED RESIDENTS

Traveling over speed humps can be painful for residents with special medical conditions, including spinal deformity, severe arthritis, or a temporary condition such as surgury recovery. Speed humps can also cause problems for disabled residents who use wheelchairs on the street. This evaluation attempted to determine the full nature and extent of these impacts by contacting members of the City's Commission on Disability, representatives from the Center for Independent Living, and the three paratransit providers who operate in the City.

Contacts with disabled residents in Berkeley indicate that a number have problems with speeds humps. Several members of the Commission on Disability indicated that they feel pain riding over the humps in a vehicle, and they know of others who also do. The amount of pain clearly depends on the speed of travel. Some slow down to nearly a full stop before crossing the humps, or cross them at an angle to lessen the impact. Only one resident has indicated that crossing the humps causes pain at *any* speed. Several disabled residents said that the bumps found in private parking lots present more of a problem than humps. Stop signs, diverters and chokers were mentioned as preferable alternatives to speed humps. (See Section XIII)

Riding over speed humps in paratransit vehicles was frequently cited by disabled residents as a problem. Paratransit vehicles are usually mini-buses, and can have a high center of gravity and a stiff suspension system. Disabled residents have complained that the paratransit drivers cross the humps too fast at times. Some of the paratransit operators agreed that humps can cause problems for disabled residents when their drivers go too fast. They claim that this will only happen if a driver does not see the speed hump, and any case of drivers going too fast over the humps should be reported to the paratransit provider. One contact mentioned that in another service area, new vehicles were purchased which had the wheelchair securement directly over the rear axle. Because of this, passengers complained about excessive jostling going over all kinds of bumps and potholes in the roads. Berkeley paratransit providers do not currently use this type of vehicle.

As described in Section III, the resident survey was also used to assess the issue of pain caused by speed humps. Respondents who indicated that they "always" or "sometimes" feel pain or severe discomfort driving over speed humps were asked to add comments on the nature of their situation. Of those who did add comments, roughly one-third described some sort of back or neck pain caused by speed humps. A few others described stomach discomfort, body aches, or pain due to recovery from surgery or accidents. Another one-third of the comments concerned the fact that the pain or discomfort varies with different vehicles, different humps and different speeds. Some feel that the posted speed of 15 mph is too fast for speed humps. Others notice discomfort only in certain vehicles, or when vehicles are heavily loaded. Still others feel that certain speed humps are steeper than others and only these cause pain or discomfort.

The issue of variability in speed hump shape is an important one and closely tied to the impact on disabled residents. Berkeley's speed humps were installed at different times and by different

contractors. While all have been installed based on the same standard, the standard allows the hump height to vary betweeen 3.0 and 3.5 inches. Some speed humps are noticeably more abrupt than others. The interface between the street and the hump edge is a critical area. Some humps curve down sharply at the street, and the sudden change in slope can cause considerable vehicle rocking. Humps that meet the street smoothly, with a gradually increasing slope, cause less jostling to passengers. This variability may result in residents taking humps too fast because of their experience with other humps that are smoother and lower.

Disabled residents may also experience pain or uncomfortable jostling when using a wheelchair in a street with speed humps. They may take their wheelchair in the street in cases where the sidewalk is in poor condition or if the curb cuts are inadequate. Some have suggested that larger gaps should be left between the humps and the curb to allow for wheelchair (and bicycle) passage. However, this would encourage swerving by vehicles to avoid the humps. A better solution is probably to repair problem sidewalks and curb cuts.

The of issue speed hump impacts on disabled residents presents a dilemma for the City, and will likely be confronted by other cities across the country in the future. In the worst case, speed humps may force residents not to use a street, thus limiting their mobility and potentially preventing them from reaching certain destinations. For most of the disabled residents contacted who experience pain at speed humps, mobility is not necessarily restricted, but travel becomes more difficult and unpleasant. If speed humps were placed at both ends of the block on which one of these residents lives, the impact on the resident would probably be excessive.

Most destinations in the City can be reached using collector and arterial streets. Speed humps will inevitably limit mobility for some disabled residents who use local streets to visit friends, for example, or simply as the shortest path to their destination. However, it is probably unfair to deprive all residents the benefits of speeds humps for this reason. Speed humps are not the only feature that can cause problems on Berkeley streets. Potholes, valley gutters (for drainage), railroad tracks, and the metal plates used for utility work are numerous on Berkeley streets. The impact of all these features should be minimized as much as possible, but driving and riding will never be free of pain for some. The speed hump program should be designed to strike a balance between minimizing the negative impacts of the program on certain users while still providing benefits to others.

Conclusion

Driving or riding over speed humps can cause pain for persons with certain physical conditions. For most of these residents, the problem can be minimized by driving very slowly over the humps. However, some persons may still have problems regardless of how slow they travel over speed humps. Riding over speed humps in paratransit vehicles can be particularly problematic as the drivers sometimes fail to slow down sufficiently. Speed humps in Berkeley often vary slightly in shape and height. Disabled residents suffer most from this variability, as higher or steeper humps can cause unexpected josteling and pain.

VIII. IMPACT ON CRIME

Since two-thirds of the speed humps in Berkeley were installed in Special Enforcement Areas, it is appropriate to ask how effective they have been in reducing crime and improving neighborhoods. Nearly all the speed humps in southwest Berkeley and west of San Pablo Avenue were installed in 1994 as part of the Special Enforcement Area Program. This was an effort to improve the quality of life on streets that were experiencing drug dealing, drive-by shootings or reckless driving. Often, the streets that suffer from these problems also have a high concentration of traffic violations. The speed humps were installed in hopes that they would help curb unlawful behavior, and thus make these neighborhoods more liveable.

The Berkeley Police Department has a community liaison who works with neighborhoods that have complaints about problems like drug dealing and reckless driving. The Police Department usually suggests a number of measures that can be taken to improve a street, such as better lighting, tree trimming, street clean-up, neighborhood watch groups, increased housing code enforcement, and heightened police presence. If these measures are ineffective, then the police may recommend speed humps to the Traffic Engineer.

Police staff have different opinions regarding the impact of speed humps on crime. According to the community liaison, speed humps can be effective in deterring drug dealing on a block. The speed humps help to give the impression that a neighborhood is organized and aware of the drug problem, which sometimes can be enough to induce drug-dealing to move elsewhere. The area around 10th Street and Channing has been cited as an example – a sharp drop in drug activity followed the installation of speed humps and stop signs.

The Police Traffic Division also feels that speed humps can be effective in controlling reckless driving. Residents in Special Enforcement Areas have complained of cars doing "donuts" in the street, and speed humps can help to limit this. However, there have also been some reports of speeds humps contributing to reckless driving. On 9th Street, there have been complaints of drivers accelerating between humps and swerving around them, treating the street as a "slalom course."

Staff from the Police Special Enforcement Unit (SEU), which deals with drug-related activity, do not feel that speed humps make any difference in the amount of drug dealing on a street. They point out that the majority of drug buyers are on foot these days. And those buying drugs from a car generally drive slowly anyway. SEU staff have even suggested that speed humps can hinder police enforcement, as drivers trying to reach the scene of an offense will be slowed.

Special Enforcement Unit Data

An attempt was made by the Police to systematically evaluate the effectiveness of speed humps in reducing drug-related offenses. The Special Enforcement Unit compiles statistics on drug-related matters investigated by the police. Any incident involving the SEU is recorded, including arrests, search warrants, complaint calls and visits to suspect residences. Narcotics offenses handled by officers from other police divisions are also recorded. All entries are identified by

location – either a street address or, more commonly, an intersection.

Using a list of Special Enforcement Area speed humps, the Police counted the incidents three years before and three years after the installation of speed humps. Records were counted for the block installed with the humps and for the block's two intersections. Because of the large amount of data, the Police could only perform the process for seven of the roughly 100 applicable blocks. The results are shown in Table 8.

Table 8: Drug-Related Incidents on Selected Blocks Installed with Speed Humps

Location	Between		Intersection of		Total Number of Incidents 3 yrs BEFORE 3/1/94	3 yrs AFTER 3/1/94
Acton	Carrison	Haskell			1	1
			Acton	Carrison	3	1
			Acton	Haskell	1	1
Acton	Haskell	67th			0	0
			Acton	Haskell	1	1
			Acton	67th	7	1
Allston	7th	8th			0	0
			Allston	7th	12	8
			Allston	8th	16	4
Allston	8th	9th			0	0
			Allston	8th	17	4
			Allston	9th	60	19
Bancroft	7th	8th			8	16
			Bancroft	7th	27	96
			Bancroft	8th	31	179
Bancroft	8th	9th			1	5
			Bancroft	8th	31	179
			Bancroft	9th	23	180
Prince	California	Sacramento			72	10
			Prince	California	110	49
			Prince	Sacramento	64	33

Note: All speed humps on these streets were installed in March, 1994.
As described in text, figures may include non-drug incidents handled by SEU.

The seven blocks evaluated show that incidents of drug activity can vary widely over time. In

some cases, such as on Allston and Prince, speed hump installation has coincided with a drop in drug activity. On Bancroft, drug incidents have skyrocketed since humps were installed. In general, it is likely that numerous other factors will tend to swamp the impact of speed humps on crime, if there is any.

Police department staff have suggested one reason for cases where incidents have increased. A program started in the early 1990s encouraged residents to call a special number when they suspect drug activity is occurring. Calls to this number were given immediate response by the SEU. Over time, as it became known that using this special number would guarantee a quick response, residents began using the number for various non-drug complaints as well. As these complaints involve the SEU, they are all recorded in the database of drug-related offenses. Thus, some of the increase may be due to non-drug incidents.

Another difficulty in evaluating speed hump impact is that most drug-related incidents seem to occur at street corners, not mid-block where the speed humps have the greatest impact. Installing speed humps on one block will have no impact on perpendicular traffic. Sorting incidents by the nearest intersection cannot reveal the impact of the humps unless they are installed on streets in both directions.

Resident Concerns

Occasionally, a resident has raised the concern that speed hump will stigmatize a block, labeling it as the site of drug dealing. A proposal for speed humps on one street was withdrawn after some residents voiced concerns about the effect on property values. There have also been occasional resident concerns that the Police will patrol a street less if it has speed humps. This is more of a concern with street barriers, many of which do not allow patrol cars to pass.

Resident concerns over speed humps in Special Enforcement Areas seem to be quite rare, however. According to Police staff, residents in Special Enforcement Areas have generally been quite pleased with the installation of speed humps. Some blocks have even held a "speed hump party" when the devices are finally installed. This conclusion is supported by the City resident survey, which found that the level of support for speed hump installation is virtually identical in Special Enforcement Areas and the "regular" speed hump areas.

Conclusion

Although two-thirds of speed humps were installed as part of the Special Enforcement Area program, there is little evidence that they have had an impact on drug-dealing and reckless driving. Anecdotal evidence suggests that speed humps have made a positive impact in some cases, often in conjunction with other neighborhood improvement measures. But conversations with Police Special Enforcement Unit staff and some limited data suggest that speed humps generally have no discernable impact on the amount of criminal activity on a street.

IX. IMPACT ON NOISE

Some residents have claimed that speed humps have led to an increase in street noise. This noise may be the result of several factors. Some vehicles travel over the humps too fast and scrape the pavement when coming down. Vehicles may also accelerate rapidly after a hump, which can increase noise. Commercial trucks and pickups sometimes carry items that can bounce loudly when going over humps. On some Berkeley streets, residents have even complained that drivers honk their horns when driving over the humps as a show of protest. On the other hand, any reduction in traffic should mean less vehicular noise on a street. And if vehicles are driving more slowly, this may also reduce noise, though not necessarily.

There have not been any "before and after" studies in Berkeley on the effects of speed humps on noise. Beverly Hills has performed a small study, using decibel meters to measure street noise near speed humps in the late evening (when background noise is minimal).[16] They found that the maximum noise level is found just after a speed hump, where vehicles are accelerating. However, the study found no significant noise difference between speed hump streets and a control street with no humps. San Jose measured noise on a selected street before and after the installation of speed humps, and found that average sound levels decreased from 77 decibels to 75 decibels.[17] A study in Britain created a model to predict the change in noise resulting from the installation of several types of speed humps and speed cushions. The study found that all types of devices decreased road noise unless a substantial number of commercial vehicles used the road.[18]

The ITE "Proposed Recommended Practice" for speed humps suggests that they will cause little net change in road noise, and possibly even a reduction. It suggests that noise levels will generally decrease with fewer vehicles and lower speeds, but may increase in the immediate vicinity of the hump, especially if there are significant numbers of trucks.[19]

This last conclusion is supported by the resident survey in Berkeley, which found that residents living in close proximity to a speed hump were more likely to notice an increase in noise than others on the street. Still, the majority of residents felt there was less noise or no change as a result of the speed humps. It may be that while overall noise levels fall, occasional loud "incidents" occur more frequently, and this is most noticeable to those living close to the hump. Overall, if vehicles are driving more slowly and there is no increase in traffic volume, speed

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[16] City of Beverly Hills, California, "Speed Humps: Implementation and Impact on Residential Traffic Control," Transportation Department, City of Beverly Hills.

[17] City of San Jose, "Interim Report on Chesbro Avenue Pavement Undulations," Department of Traffic Operations, February 1983.

[18] Abbott, P.G. and R.E. Layfield, "The change in traffic noise levels following the installation of speed control cushions and road humps," *Proceedings of Internoise 96*. Vol. 4, 1996

[19] "Guidelines for the Design and Application of Speed Humps: A Proposed Recommended Practice."

humps can be expected to lower average traffic noise, but could potentially increase noise close to the humps.

Conclusion

Speed humps will cause little or no change in noise levels. While noise in the immediate vicinity of a speed hump may increase slightly due to vehicles accelerating, scraping the pavement or rattling their cargo, overall vehicle noise levels in the neighborhood will likely remain unchanged or decrease.

X. IMPACT ON OTHER CITY SERVICES

Non-emergency service providers in the City negotiate speed hump streets on a regular basis. As part of this evaluation, staff were contacted in the City's solid waste, recycling, street sweeping and Public Works departments. The three paratransit operators in the City were also contacted. There are no reports of speed humps causing any problems for these service providers. It was mentioned that it is important to keep the speed humps well marked to ensure that service drivers are able to see them.

Information from other cities indicates that speed humps have not been associated with any problems for garbage collection or recycling. Pasadena found that speed humps did affect street sweeping in that a small amount of debris is sometimes left at the speed hump.[20] Occasionally, resident complaints require that a street be re-swept for this reason. However, Berkeley street sweepers do not have this problem.

Conclusion
Speed humps have had little or no adverse impact on non-emergency city services such as garbage collection, recycling or street cleaning.

[20] City of Pasadena.

XI. IMPACT ON ACCIDENTS AND SAFETY

Speed humps are designed to encourage motorists to drive more slowly and cautiously, and thus make streets safer and more liveable. A safer street means both a reduced likelihood that a pedestrian will be hit by a vehicle and a decrease in vehicle accidents.

Pedestrian Safety

It is difficult to find evidence of an increase in pedestrian safety because pedestrian accidents on local streets in Berkeley are rare. Most typical local streets never have a reported pedestrian accident. The nature of residential traffic is always changing, due to such factors as the increasing number of vehicles in the City, changes in vehicle types, and more arterial congestion. It is therefore difficult in Berkeley to isolate the impact of speed humps on a rare occurrence such as a pedestrian accident on a local street.

Certainly slower speeds do reduce the chances that a pedestrian will be injured if hit. The UK Department of Transportation has estimated that the chances of a pedestrian surviving a collision increase tremendously when the vehicle slows to only 20 mph, as shown below.

Vehicle Speed	Chance of Death
20 mph	15%
30 mph	45%
40 mph	85%

Source: "Killing Speed and Saving Lives," UK Dept of Transportation as cited in Greenwald.

Drivers generally reach their highest speed mid-block, slowing down at intersections. Studies have found that young children are more likely to be hit by a car mid-block, while older children are more often hit at intersections.[21] Speed humps are thus particularly effective at increasing safety for the young who have not yet learned of the dangers of vehicle traffic.

The primary purpose of speed humps is, of course, to make streets *feel* safer. Changes in accident numbers, even if they were available, would not reveal the true effectiveness of speed humps. Research by Appleyard and others has shown what most people intuitively believe: higher traffic speeds and volumes generally mean a lower quality of life for the abutting residents.[22] High traffic speeds will likely cause parents to worry more about their children playing outside or even prohibit it altogether. It may even reduce social interaction and neighborhood feeling among residents.

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[21] See Homburger et al, *Residential Street Design and Traffic Control*, ITE, 1989, and Burden, Dan and Michael Wallwork, P.E., "Handbook for Walkable Communities," (unpublished).

[22] Appleyard, Donald, *Livable Streets*. University of California Press, Berkeley, California, 1981.

Traffic Safety

Vehicle accidents are more common than pedestrian accidents, but the vast majority still occur on arterial and collector streets. The City established a traffic enforcement unit in 1990, and this has probably contributed to a reduction in traffic accidents in recent years. As nearly all the speed humps were installed after 1990, it is impossible to determine whether or not speed humps have played a part in this reduction or not.

Few other cities have been able to compile meaningful accident data before and after the installation of speed humps. Data that has been collected often shows only that accidents have not increased. In Omaha, Nebraska, for example, accident statistics were collected at 19 locations where two or more speed humps were installed. No significant increase in accidents occurred near the speed humps.[23] The ITE "Proposed Recommended Practice" suggests that accidents will likely remain unchanged or be reduced as a result of lower speeds and/or volumes.

In addition to reducing speeds, humps tend to make speeds more uniform along a block, reducing the variance in speeds. Traffic engineers generally consider this to be a safer operation since encounters between vehicles moving at greatly different speeds can lead to accidents.

It is possible, though unlikely, that speed humps could contribute to a vehicle accident by forcing a speeding driver to lose control. While the Police Department does have a database of accidents, individual records do not specify whether or not speed humps were involved. Further, the vast majority of collisions are not reported to the Police. Police staff have no recollection of speed humps causing any accidents, except for one incident involving a young boy on a bicycle using a speed hump as a jump. The ITE "Proposed Recommended Practice" states: "Speed humps have not been found to pose a traffic safety hazard when properly designed and installed at appropriate locations."

Conclusion

Traffic accidents involving pedestrians and other vehicles are infrequent on local residential streets, and therefore the impact of speed humps on pedestrian accidents cannot be accurately quantified at this time. Speed humps probably have little impact on overall accident rates. However, the real benefit of speed humps comes from a perceived increase in safety and liveability due to lower traffic speeds.

[23] Klik, Marcel and Ardeshir Faghri, "A Comparative Evaluation of Speed Humps and Deviations," *Transportation Quarterly*. Vol. 47, No. 3, July 1993.

XII. IMPACT ON BICYCLISTS

Berkeley is committed to making the City more "bicycle friendly," so it is important to consider the impact of any traffic calming measure on cyclists. Ideally, speed humps will reduce the impact of motorized traffic on streets, thus making them easier places to bicycle. However, if speed humps make cycling too uncomfortable, cyclists may move to higher volume streets which are less safe.

As with some disabled residents, bicyclists can be particularly sensitive to minor variations in speed hump shape and height. A hump that rises too abruptly or lacks a smooth interface with the street surface can be uncomfortable and potentially dangerous for cyclists. One publication suggests that to accommodate bicyclists, the hump gradient at the approach and exit slopes should not exceed 16%.[24] The specifications for Berkeley's speed humps have a maximum gradient of 9% at the approach and exit slopes, though there is considerable variation in the actual installation.

One alternative for reducing the impact of speed humps on cyclists would be to leave a larger gap between the speed hump and the curb, allowing cyclists to avoid the hump altogether. According to the existing specifications, speed humps in Berkeley should taper off two to three feet from the curb. Cyclists can sometimes use this gap to avoid the speed hump, but parked vehicles often block it. In addition, a gap between the speed hump and curb can also encourage vehicles to swerve to avoid the hump, reducing their slowing effect and potentially endangering cyclists. This "gutter running" would likely increase if the gap were made larger.

When speed humps are installed on streets with bike lanes, the impact on cyclists may be more acute as cyclists expect the lane to be relatively free from impedances. Leaving a larger gap for bicycles may be possible in these cases, since the solid white line will help to keep motorists in the traffic lane. The ideal solution would be to employ some sort of raised median or island which forces vehicles to traverse the speed hump but provides cyclists (and wheelchairs) with a clear path along the curb. This would substantially raise the installation costs, however. Some cities have required that when humps are installed on bike lanes streets, the humps must not taper off within the bike lane – that is, the hump has a constant cross-section across the bike lane. This is done to avoid the potentially dangerous situation of riding along a sloping surface.

Informal inquires suggest that most cyclists in Berkeley don't mind speed humps, particularly if the humps work to reduce traffic speeds and/or volumes. Those that do object to humps are often more experienced cyclists who like to ride fast and without interruption. The resident survey suggests that the opinions of cyclists regarding speed humps are little different from residents who travel primarily by car. Of the 4% of respondents to the survey who identified "bicycle" as their primary mode of travel, 50% support further speed hump installation, 23% had no opinion, and 27% were opposed. These percentages are very close to those of the entire survey population. Evaluations from other U.S. cities indicate that, outside of Berkeley, speed humps

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[24] *Cyclists and Traffic Calming.* Cyclists Touring Club, U.K., 1991.

are generally considered to have no impact or a positive impact on bicycling.

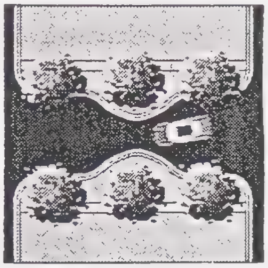
Conclusion

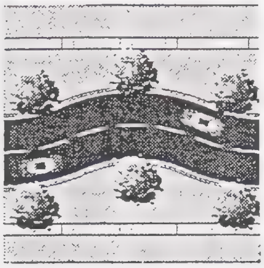
Speed humps can be uncomfortable to some bicyclists, particularly when the humps rise abruptly or lack a smooth interface with the street pavement. Providing a gap between the speed hump and the curb can allow uninterrupted passage for bicyclists, but may also encourage motorists to swerve toward the curb. Speed humps installed on streets with bike lanes could be potentially dangerous if the hump tapers off mid-way across the lane. Limited evidence in Berkeley suggests that most cyclists do not mind speed humps, especially if they reduce traffic speed and/or volume.

XIII. ALTERNATIVES TO SPEED HUMPS

Speed humps work very effectively to reduce mid-block vehicle speeds. There are, however, a number of alternatives which may be effective at reducing speeds depending on the circumstances. Most of these alternatives can be categorized as causing either horizontal displacement of vehicles (chokers, chicanes, islands, traffic circles, striping) or vertical displacement (speed tables, speed cushions, rumble strips). Table 9 summarizes these alternatives.

Chokers and Chicanes





Apart from speed humps, one way to reduce speeds is to narrow a street. While reconstructing an entire street is prohibitively expensive, various means can be employed which effectively narrow portions of the street. Two of these measures are know as chokers and chicanes. Chokers (or pinch points) are extensions of the curb at mid-block that act to reduce the street width at one point. Street width may be reduced to allow two narrow traffic lanes, or two lanes can be narrowed to one. If properly designed, drivers may slow down at a street narrowing out of caution, while others may be forced to slow or stop if the street becomes too narrow to allow opposing cars to pass. On busy streets, chokers can make it easier for pedestrians to cross by effectively narrowing the crossing width. Similar to chokers, bulb-outs are curb extensions at an intersection, and are a common means of making commercial districts more pedestrian-friendly. Intersection bulb-outs, however, will not do much to reduce speeds at mid-block.

Chokers may result in slight speed reductions in some cases, though not as much as speed humps. Unfortunately, there is little research on the effects of mid-block chokers on vehicle speeds. One study found that reducing the street width to 11 feet at point resulted in almost no speed reduction.[25] Stockholm, Sweden has documented the effects of installing chokers and speed humps on similar streets. They found that the chokers reduced speeds about 4 mph and the speed humps reduced speeds 9 to 12 mph.[26] Speed reductions at chokers will be greater when traffic volumes are high, because a vehicle that meets an oncoming vehicle must wait for the other to pass, or at least slow down so both can pass through the narrow portion. An isolated vehicle using the street may not be slowed at all. The diversion of non-local traffic will probably not be significant, unless extensive slowing of vehicles occurs.

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[25] Marconi, William, "Speed Control Measures in Residential Areas," *Traffic Engineering*. Vol. 45, No. 11, November 1976, as cited in City of Portland, Neighborhood Traffic Management Program.

[26] City of Portland, Neighborhood Traffic Management Program.

Table 9: Matrix of Traffic Calming Tools and Their Effects

Tool	Speed Reduction	Traffic Diversion	EMS Delay	Other Advantages	Other Disadvantages	Cost
Chokers	Yes, if narrowed to one lane	Slight	Minor	Use for landscaping	Parking removal	$20,000 - $40,000 per pair
Chicanes	Yes, if they force a significant deviation	Slight	Minor	Use for landscaping	Parking removal	$24,000 - $45,000 per pair
Medians	Slight, if narrows lane width	Slight	Minor	Use for crosswalk	Need wide street	$15,000 - $40,000
Traffic Circles	Slight; reduction w/in 200 ft only	Slight	Major, if previously uncontrolled	Use for landscaping; accident reduction	Little impact on long blocks	$20,000 if landscaped
Narrow-lane Striping	Little or none	Little or none	No	Can serve as bike lanes		$250 per block
Speed Humps	Yes	Varies -- Potentially High	Major	No parking removal	May cause discomfort for disabled.	$1500 each
Speed Tables	Yes	Varies -- Potentially High	Major	Potential crosswalk	May cause discomfort for disabled.	$2000 each
Speed Cushions	Yes	Varies -- Potentially High	Minor	No parking removal	May cause discomfort for disabled.	$1500 per pair
Textured Pavement	Little or none	No	No	Use for crosswalk	May be uncomfortable for bikes	Varies
Police Enforcement	Yes, temporarily	No	No	Can respond to problem areas	Limited coverage	Varies
Education	Little or none	No	No	Community involvement		Varies
Stop Signs	Little or none	Slight	Minor	Can help ped and bike crossing	May be ignored if unwarranted	$100 - $200
Full Diverters	Yes	Yes	Major	Potential to use for landscaping	Significantly alters traffic circulation	$1000 for bollards; $25,000 + if landscaped
Half Diverters	Yes	Yes	Minor	Can be temporary	May be violated	$500 for bollards, $20,000 + if landscaped

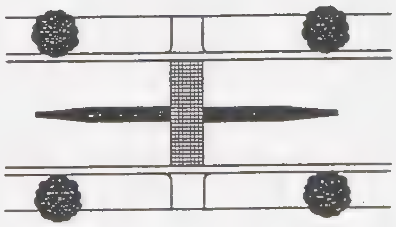
Chicanes are alternating curb extensions that force drivers to shift direction as they travel down the street. Milvia Street between Cedar and University has examples of chicanes. As with chokers, there are only a few cases where the impact of chicanes has been documented. Seattle installed two sets of chicanes on a residential street, and found that speeds were significantly reduced at the chicanes, though not between them.[27] Traffic volume also dropped on the street. Obviously, the degree of reduction in vehicle speed will depend on the amount of deflection from a straight travel path. In one example in Britain, a system of chicanes was installed on a major street because of fire department objections to the use of speed humps. The chicanes forced two traffic lanes down to one at various points on the roadway, alternating from one side to the other. The system was quite effective at reducing vehicle speed – the 85th percentile speed fell from 38 mph to 30 mph, and was even lower during high-volume periods when opposing vehicles confront each other at the constrictions.[28]

Both chicanes and chokers have one significant advantage in that they can be used for trees and landscaping, and thus can beautify a street much more than speed humps. Portland has often used chokers often in combination with traffic circles, and both are planted with trees and grass or low shrubs. Chokers and chicanes will also cause less delay to emergency vehicles, and probably have less potential to cause vehicle damage.

There are some major disadvantages with the use of chokers and chicanes. They are quite expensive compared to speed humps – a pair of chokers or chicanes (one on each side of the street) will cost $24,000 to $45,000, roughly eight to fifteen times the cost of a pair of speed humps. They will probably require the removal of some on-street parking. They may also increase the potential for vehicular accidents.

In addition, care must be taken so that chokers, chicanes and other lane-narrowing devices do not adversely impact cyclists. Unless vehicle speeds are low, cyclists may get squeezed at narrow points or even cut-off. To prevent this, European communities have used speed humps at chokers which slow vehicles to bicycle speed. Alternatively, the curb extension could be constructed with a gap for cyclists.

Median / Pedestrian refuge island



A raised island installed in the middle of the street may slow vehicles by narrowing the lane and

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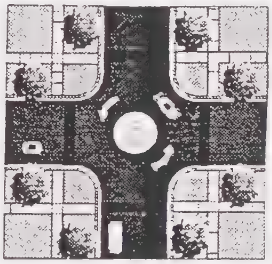
[27] Ibid.

[28] Broadbent, K. and A.M. Salmon, "An alternative to road humps," *Highways and Transportation*. Vol. 8, No. 40, August 1993.

possibly forcing vehicles to move to the right in their travel path. On busy streets, they can be used at a crosswalk to provide a refuge for pedestrians crossing the street one lane at a time. The effects of medians and islands on vehicle speeds will be similar to chokers, and will depend on the degree of lane narrowing and vehicle diversion. In Anne Arundel County, Maryland, traffic-calming medians have been supplemented with small mid-block curb extensions that narrow the traffic lane. Studies have shown that medians can reduce 85th percentile speeds by 2 to 5 mph.[29] They will probably not reduce speeds as much as speed humps.

Most residential streets in Berkeley are probably too narrow to allow installation of islands. In addition, like chokers and chicanes, they require extensive reconstruction and are relatively expensive. But they may be appropriate for certain high volume streets at pedestrian crossings.

Traffic Circles



Traffic circles are landscaped islands in the center of an intersection that force vehicles to slow down and turn right around them in order to proceed. They differ from the much larger roundabouts which are typically located on higher volume streets. Berkeley has one example of a landscaped traffic circle at the intersection of Woolsey and Regent Streets. Several more circles have been created using clusters of bollards, such as those on California Street at Allston and at Channing. Seattle, Washington has been installing traffic circles for nearly 20 years, and now has hundreds of them.[30] Portland's Neighborhood Traffic Management Program has also installed a large number of traffic circles over the past 10 years.

Traffic circles work to reduce vehicle speeds at intersections and may reduce speeds mid-block. When traffic circles appear frequently between short blocks, motorists may drive more slowly knowing that they will soon be forced to slow down. Traffic circles also work to reduce speeds because they interrupt sight-lines beyond one block. Drivers seeing a long, straight stretch of road often drive faster, and anything that disrupts that view will encourage some slowing.

Portland has performed a comprehensive study of the impact of their traffic circles.[31] They have found them to be effective at reducing speed mid-block and at intersections, as well as reducing intersection accidents. The 85th percentile speed mid-block is generally reduced 4 to 6 mph by the traffic circle. The Portland study found that speed reductions vary by the time of day, with

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[29] Walter.

[30] Von Borstel, Edwin W., "Traffic Circles: Seattle's Experience," *ITE Compendium of Technical Papers*. 1985

[31] City of Portland, Neighborhood Traffic Management Program.

the greatest reductions coming in the morning peak hour. Larger diameter traffic circles (24 feet) reduced speeds more than smaller ones (18 feet).

Berkeley has recently considered installing more traffic circles, and the experiences of Portland should be used to help predict their impact. Traffic circles do not reduce mid-block speeds as much as speed humps. In addition, the impact of traffic circles on vehicle speed clearly diminishes farther from the intersection. The blocks in the vicinity of the Portland study were 200 - 300 feet long and as such, drivers are never more than 100 - 150 feet from an intersection. Traffic circles would not be as effective at reducing mid-block speeds on longer blocks. A typical block in Berkeley (say, Fulton to Ellsworth) is about 600 feet long.

In Berkeley, traffic circles have been proposed both for uncontrolled intersections and for those that currently have two- or four-way stop signs. The slowing effect of a new circle would obviously be less where intersections are already controlled with stop signs.

The evaluation from Portland also echos a finding in other studies – that speed reduction depends on the amount of lateral displacement of vehicles. Larger circles in Portland caused lower speeds than smaller circles. This suggests that the makeshift traffic circles in Berkeley formed by bollard clusters are considerably less effective at reducing mid-block speeds because they cause less lateral movement than landscaped circles. While no before and after speed studies have been performed on traffic circles in Berkeley, it seems likely that the bollard circles have little or no significant impact on mid-block speeds. If traffic circles are to be used as an alternative to speed humps, they must be installed with full curbs and landscaping.

Aside from speed control, traffic circles have a number of advantages over speed humps. Traffic circles can dramatically improve the appearance of a neighborhood when properly landscaped. In Portland, they are planted with trees and shrubs and become something of a neighborhood garden. They usually reduce intersection accidents as they reduce the possible collision points. Several studies have shown sometimes dramatic reductions in accident rates where traffic circles have been installed.[32] Traffic circles do not appear to significantly reduce traffic volumes, and hence do not cause the sort of diversion of traffic that speed humps can cause.

If traffic circles are installed in place of stop signs, there will likely be some reduction in fuel consumption and emissions. In Toronto, Ontario, fuel consumption in a test vehicle dropped 32% on a street where traffic circles replaced stop signs.[33] Traffic circles have not caused any problems for bicycles or pedestrians in Portland.

Installing a traffic circle is relatively expensive as it requires significant construction work and probably the re-arrangement of a sewer access point. The estimated cost for installation in

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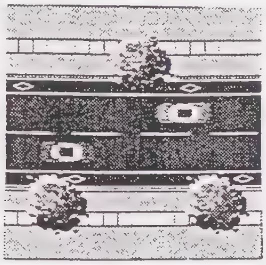
[32] Von Borstel.

[33] City of Toronto, Ontario, "Balliol Street Traffic Calming Pilot Project – Interim Monitoring Report," Department of Public Works and the Environment, City of Toronto, June 6, 1995.

Berkeley is $20,000. Maintenance of the circle and landscaping would be an additional yearly expense.

Striping



Traffic calming measures in general must cause either a vertical or lateral displacement in order to affect vehicle speeds. However, sometimes simply making a street appear narrower may slow down traffic. One way to do this is to paint shoulder stripes which create the impression of narrow lanes. This technique has been employed on Milvia Street, in conjunction with other measures. Striping of this sort is inexpensive, roughly $250 for a block. It can also be used to add a bicycle lane if space is sufficient. However, there is little evidence that narrow striping will significantly reduce vehicle speeds. In a 1980 Federal Highway Administration study, residential streets were painted with 9-foot lanes in order to give the impression of a narrow street. The study found that the striping had no significant effect on vehicle speeds.[34] However, Anne Arundel and Howard counties in Maryland have achieved speed reduction of 3 to 4 mph on residential streets by painting parking lane lines that narrow the available roadway.[35]

Cities have experimented with other "psycho-perceptive" traffic calming measures as well. In one case, stripes were painted perpendicular to the roadway which become increasingly close together. The pattern is intended to give drivers the illusion of high speed and encourage them to slow down. The study found 85th percentile speeds were reduced by 5 mph on average.[36]

Inexpensive measures such as these might warrant further investigation in Berkeley. For example, striping to reduce lane width could be used as a first step toward reducing speeds on arterial streets, as they would likely cause little or no traffic diversion. If speeding is a serious problem on a local street, however, it is likely that more intensive measures will be needed.

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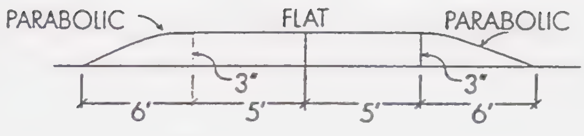
[34] Lum, H.S., "Use of Road Markings to Narrow Lanes for Controlling Speeds in Residential Areas," *ITE Journal*. Vol. 54, No. 6, June 1994.

[35] Walter.

[36] Frangos, George E., "Howard County's Speed Control in Residential Areas Utilizing Psycho-Perceptive Traffic Controls," ITE Compendium of Technical Papers, 1985.

Wide Speed Humps / Speed Tables



A number of communities, including Berkeley, have experimented with a wider speed hump as an alternative to the standard 12-foot, parabolic-shaped hump. These wide humps, sometimes called "speed tables," are generally 22 feet wide, with six-foot ramps on either end and a ten-foot flat section in the middle. The flat portion is wide enough so that the entire wheelbase of a passenger car can rest upon it. The wide speed hump is significantly less jarring than the standard hump – most vehicles can drive over them comfortably at 25 mph.

As discussed earlier, several communities have had successful experiences with wide speed humps, including Howard County, MD, Seminole County, FL, Portland, OR and Austin, TX. Portland authorizes wide humps for collector streets, and local streets which are Emergency Response Routes or carry high volumes. Seminole County has installed them on colletor roads with over 12,000 vehicles per day.[37] Wide humps have been found to reduce 85th percentile speeds by 6 to 11 mph, as is described in more detail in Section IV.

Wide speed humps can also function as a mid-block crosswalk if they are flat on top and marked appropriately. Some European cities have installed this type of speed hump using cobblestones or colored paving blocks for the flat portion. Pedestrians are more visible on the hump, and traffic speed will be at its slowest. Tallahassee, Boulder and Howard County have all used wide speed humps in this fashion.

Because they are designed to allow higher speeds, wide speed humps may not do enough to slow vehicles on residential streets. As discussed in Section IV, the 22-foot wide humps on Santa Fe Avenue in Berkeley seem to be effective so far. In Ft. Lauderdale, however, city staff found that the wide, flat-top speed hump was not reducing vehicle speed enough.[38] In an attempt at a compromise, they have since installed speed humps with a different profile: 22 feet wide, but with a curved shape and greater rise. Broward County, Florida has experimented with another shape of speed hump: 14 feet wide, with 4-foot ramps at each end and a 6-foot flat section in the middle.[39]

There seems to be great potential to vary the height, length and shape of speed humps so they can be tailored to the particular characteristics of a street. Streets that serve emergency vehicles, carry higher volumes or serve commercial vehicles can get humps that are wider and flatter. Researchers in Australia, for example, have performed tests to develop a speed hump for use on bus routes. The design they found most suitable was 36 feet wide and 2.5 inches high, with a 24-

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[37] Walter.

[38] Ewing, Reid and Edith McClintock, "Traffic Calming in America," (unpublished) 1997.

[39] Ibid.

foot platform and 6-foot ramps.[40] Streets near schools and parks, or streets that carry only local residents, could be installed with more traditional speed humps that force greater slowing, with the hump height adjusted based on the extent of the speeding problem. Researchers have even proposed a model which would allow the custom design of speed hump geometry based on the desired 85th percentile speed.[41] More research and experience needs to be accumulated before the City begins to vary speed hump design. But such a solution may prove to be helpful in finding a compromise between the competing interests on Berkeley streets.

Speed Cushions

Speed cushions are raised platforms in the street that cover only one lane or a portion of one lane. Effectively, they act like speed humps for most vehicles, but fire engines and buses with greater axle-width can pass over them unaffected. Speed cushions have been used extensively in Germany and the Netherlands.[42] In theory, they could reduce speeds much like speed humps, and probably at a similar cost. Speed cushions would also be unobtrusive to bicycles. However, their effectiveness is compromised if drivers could swerve to avoid them, a likely occurrence on any low-volume local street. For this reason, European cities have often used them with a raised traffic island that prevents drivers from leaving their lane. Speed cushions can also cause problems for fire trucks and buses with double rear wheels. The space between inner tires is less than on the front axle on these vehicles, and more akin to the width of a passenger vehicle axle. If these inner wheels can't straddle the speed cushions, it could cause overloading of the wheels. Berkeley's fire engines and trucks all have double rear wheels.

Similar to speed cushions, there have been proposals for speed humps with gaps which allow unaffected passage of wide-axle fire engines. This would have similar constraints as speed cushions in that it would have to be designed based on fire engine axle width, and would present problems for double-wheel vehicles. Tests in Denmark have been performed on a "combination speed hump" – one that has wide, gradually-sloping ramps on the outside and a sharper, parabolic hump in the middle.[43] If designed correctly, fire engines could use the outside humps and be forced to slow less than passenger vehicles, which would face the steeper, inner hump. Again, this design might pose safety problems for vehicles and bicycles, and does not warrant serious consideration without more testing and trials. Also, Berkeley Fire Department staff have noted that they place a high priority on watching for pedestrians and bicycles when using residential streets, and negotiating a special type of speed hump might distract them from this.

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[40] Jarvis, J.R. and G. Giummarra, "Humps For Use On Bus Routes," *Road and Transport Research.* Vol. 1, No. 4, December 1992.

[41] Fwa, T. F. And C. Y. Liaw, "Rational Approach for Geometric Design of Speed-Control Road Humps, *Transportation Research Record 1356.* 1992.

[42] Hass-Klau, Carmen, Inge Nold, Geert Böcker and Graham Crampton, *Civilised Streets: A Guide to Traffic Calming.* Environmental & Transport Planning (U.K.), 1992.

[43] Jarvis.

One promising variation on the speed hump/cushion is to split the hump and stagger the halves by roughly 50 feet. Each portion of the hump covers only half the street, and the large space between the humps allows emergency vehicles to avoid passing over the hump by swerving to the other side of the street. Portland, Oregon has installed a trial set of humps of this sort, with very positive initial results. They have installed a small raised median in the center of the street, preceding hump in the direction of travel. A "Keep Right" sign installed in this median discourages non-emergency vehicles from swerving around them. These staggered humps have been monitored with 24-hour surveillance cameras, and there have been virtually no vehicles violating the sign thus far. Tests with fire vehicles found that the delay caused was almost negligible. One limitation, however, is that the staggered humps need a fairly wide street if fire vehicles are to maneuver around the humps. Portland does not anticipate installing them on any street less than 36 feet wide, a width greater than many of Berkeley's residential streets. However, if further tests with these humps confirms their success, Berkeley should consider them for some wider local streets with speeding problems.

Textured Pavement / Rumble Strips

Textured pavement is designed to provide a visual or physical sensation which reminds drivers that the road is shared with pedestrians. It is often employed at crosswalks, and can be found in Berkeley at several locations on San Pablo Avenue as well as on Milvia. Cobblestones, bricks or colored concrete can all be used to create textured pavement. It should be used primarily as an attention-getting device, encouraging drivers to be more cautious, but will not do much for speed control.

Rumble strips consist of patterned strips in the road which create a rough surface – often grooves in the pavement or rows of raised buttons. They have been used for years to warn motorists of an upcoming curve, stop sign or traffic signal, mostly on highways and major streets. Several cities have used rumble strips on residential streets, though usually to alert drivers to changes in traffic patterns rather than for speed control. The few studies that have been done on rumble strips found them to be largely ineffective in reducing speeds, though they do seem to reduce certain types of accidents. Rumble strips may be inappropriate for some residential streets because they can cause an increase in noise. They are also uncomfortable and slippery to bicyclists.

Police Enforcement

If vehicles are grossly exceeding the local street speed limit of 25 mph, increased enforcement by traffic police may help to reduce the problem. This is typically one of the first steps taken when a speeding problem is identified. Streets chosen for selective enforcement will get extra attention from traffic police, and speeders using the street regularly will hopefully modify their behavior as the chances of citation increase. Enforcement can be conducted during time periods that are deemed to be the most problematic. (However, in Berkeley, traffic police work only Monday through Friday, from 7 am to 7 pm.) The Berkeley Traffic Police feel that increasing the staff of the traffic division would be a more effective tool to deal with speeders than speed humps.

The Police Department has a small portable trailer that automatically measures vehicle speed using radar and posts it on a large digital display board. The trailer can be parked at strategic locations, and passing drivers will see their speed and possibly slow down as a result. As regular drivers become "educated" about their speed, they may drive in a manner more appropriate to local residential streets. It also alerts drivers that someone is paying attention to speeding and that the area may get police enforcement.

Selective enforcement will probably not cure all speeding problems, however. The Berkeley Police force has many obligations, and only a limited time can be spent at any given street. Traffic enforcement is not one of the highest priorities for the Police Department. There are currently four full-time traffic police officers in Berkeley, plus two half-time officers. The Police Department has authorization to hire two more traffic officers, but this is unlikely in the near future unless priorities change.

If high speeds are reduced as a result of the enforcement, the speeders may well resume when the enforcement moves elsewhere, as eventually it must. In addition, under California law, tickets can only be issued to vehicles traveling in excess of the 85th percentile speed unless other conditions warrant lower speeds. On many residential streets in Berkeley, the 85th percentile speed may be over 30 mph. Thus, some of the vehicles contributing to a perceived speeding problem may not be exceeding the speed at which tickets can be issued.

Education

Neighborhood speeding problems are often a result of differing perceptions of appropriate speed. Drivers usually choose their speed based on street width, sight lines, grade, pavement condition, etc. The speed they choose is often higher than what residents feel is appropriate, particularly residents with children and pets. In addition, Berkeley Police staff have remarked that those caught speeding on local streets are often residents of the neighborhood themselves. Many people simply don't realize how fast they are going, or don't know the speed limit. Riding in a newer car with a smooth suspension and quiet interior can make 35 mph feel like 25 mph. If this is the case, a campaign to educate local residents about the importance of obeying the speed limit may have some positive effects.

Many neighborhoods and cities have implemented some sort of speed education program. A neighborhood in Pleasanton, California, for example, has started a "Drive 25" campaign with the local police department. Flyers were distributed which remind residents of the speed limit, show a map of recent accident locations, and announce a special enforcement program. The City of Oakland started a "Drive Cool" promotion as part of its Neighborhood Traffic Control Program. Staff have appeared at community centers and special events with posters and brochures (in several languages), targeting mostly young drivers. The program continued in high schools and driver's education classes.

Neighborhood groups that organize around traffic problems can help to identify chronic speeders. In Sunnyvale, part of the neighborhood education program involves the Police Department

lending radar guns to neighborhood representatives. Residents use the radar guns to identify those drivers who are repeatedly speeding, and the Police then send a letter to the drivers which calls attention to their behavior. The City of Phoenix has a similar program.

Education, like enforcement, is a good first step, but will probably not cure persistent speeding problems. There is little or no evidence documenting the effects of these programs. However, these types of efforts should not be ruled out, particularly if outside funding can be secured. Such a program probably stands a good chance of winning grant funding either from the federal level or from the State's Office of Traffic Safety.

Stop Signs

Residents often request the installation of stop signs in hopes of curing a speeding problem. Yet stop signs are traffic control devices, designed to meter and control the flow of vehicles at an intersection. Stop signs are usually installed only if an intersection meets minimum warrants – that is, if traffic volume is high enough to justify a stop sign as a traffic control device. They are effective at reducing accidents when such warrants are met. Stop signs may be installed at other intersections in special circumstances, such as near schools, parks or bike paths.

Stop signs will usually do very little to control mid-block speeds unless blocks are very short, and they may even increase speeds if drivers hurry to make up for time lost in stopping. Some evidence does exist that stop signs may help to lower the very highest speeds on a street, while having little effect on average or 85th percentile speeds. It has been suggested that this may be part of the reason for their persistent popularity with residents.[44] Portland has carried out a comprehensive evaluation of stop signs and their effects on accidents and speeds. They found that, in general, mid-block speeds did not change significantly when two-way stop signs were installed at previously uncontrolled intersections. Where all-way stop signs were installed, mid-block speeds may decrease. However, if the stop signs were unwarranted, compliance was often poor and the frequency of accidents at the intersection increased.[45]

This last point is important when considering new stop signs. Unwarranted stop signs may be ignored by motorists, creating a situation that is dangerous for other vehicles as well as cyclists and pedestrians. Stop signs should not be used for controlling speeds on residential streets; rather, they should continue to be used only as traffic control devices where warranted or in special circumstances.

Diverters

Berkeley has an extensive system of traffic diverters and street closures dating back to the mid-1960's. Currently in the City there are about 48 street closures or full diverters (most of which

[44] Homburger et al.

[45] City of Portland, Neighborhood Traffic Management Program.

allow emergency vehicle passage), and 14 half-diverters (which allow vehicles to pass in one direction). Diverters are used to reduce traffic volume by blocking all or some of the vehicles trying to by-pass arterial streets. They are not speed control devices and should not be used as such.

Often, however, high vehicle speeds are found in conjunction with heavy traffic. Cut-through drivers are probably more likely to use excessive speed, and if these vehicles are discouraged from using a street, speeds may be reduced. While circumstances for the use of diverters is beyond the scope of this evaluation, diverters will continue to be used as part of neighborhood traffic control. Half-diverters may be a good compromise, allowing emergency vehicle passage while limiting some traffic. Another option is to use striping and signage to restrict certain movements at an intersection. Westbound Channing at Martin Luther King provides a good example of a this tactic: Vehicles are forced to turn left or right, while a special lane allows through movement for bicycles.

Conclusion

Of the accepted traffic calming measures used in the U.S. today, standard 12-foot wide speed humps remain the most effective device to reduce mid-block speeds without blocking access. Other devices can be effective to a lesser degree, and may be appropriate for some locations in Berkeley where standard speed humps cannot be used. Varying the length and shape of speed humps appears to be the most promising alternative – specific traffic conditions or the needs of emergency vehicles can be accommodated by using wider, flatter speed humps. The 22-foot speed humps found on Santa Fe Avenue have proven to be effective at reducing speeds in Berkeley and several other communities.

Chokers, chicanes and traffic circles have also been shown to reduce speeds on residential streets, though not as much as speed humps. These devices are substantially more expensive than speed humps, but they do offer the opportunity for landscaping and neighborhood beautification. Mid-block chokers should be considered for streets with speeding problems where speed humps cannot be installed. Large, fully landscaped traffic circles should also be considered on shorter blocks, but they will have little or no impact on long blocks.

Selective enforcement by traffic police and neighborhood education programs should continue to be used as a first step to solve speeding problems. Other devices, including striping narrow traffic lanes, textured paving and stop signs, are generally not effective at reducing mid-block speeds. They may be appropriate for other reasons, or in conjunction with other traffic calming devices. For example, a speed table can function as an attractive and effective mid-block cross-walk, or travel lanes can be narrowed by adding bike lanes.

XIV. RECOMMENDATIONS

Examining the evidence on the impact of speed humps and their alternatives, it is clear that no solution will completely satisfy all interests. Speed humps make residential streets feel safer and more liveable. Yet any device added to a street that slows passenger vehicles will inherently do the same to emergency response vehicles to some degree, and may limit the mobility of certain disabled residents. The issue boils down to this: at what point do the impacts of slowing emergency response vehicles and limiting mobility outweigh the benefits of more liveable streets. Data and studies can help to clarify the issue, but it is ultimately a question of values that must be decided by the City's elected officials.

Based on this evaluation, it is recommended that the City continue the use of speed humps on residential streets to control speeding problems, and that the selection process be modified so as to minimize the negative impacts of speed humps. These modifications are detailed in the following points:

1. Speed humps should not be installed on routes identified as Primary Emergency Response Routes. The Berkeley Fire Department and Police Department should be consulted for every proposed speed hump installation. This review may identify streets other than primary response routes where speed hump installation would create problems for emergency response vehicles. The Fire Department has prepared a map on which they have classified all City streets as primary, secondary or tertiary response routes. (See Appendix K) This map, while still in draft form, will serve as a starting point for discussions over the appropriate location for speed humps.

2. The speed hump petition form should be revised to inform residents of the delay that speed humps can cause to emergency vehicles. A proposed form is attached at Appendix L.

3. Wider speed humps, such as 22-foot humps, should be used in situations where Traffic Engineering staff feel that they are more appropriate than the standard 12-foot speed humps. This type of device has been shown to have less impact on Fire Department vehicles. It should be recognized that over time, wider speed humps may not reduce 85th percentile speeds as much as the standard humps, and the standard humps should continue to be used in appropriate situations. If no type of hump can be used on a local street with a persistent speeding problem, alternatives such as chokers, chicanes or traffic circles should be considered.

4. Speed humps should not be installed or should be modified on blocks where there is an abutting resident who objects to the installation because of special medical conditions. This stipulation is designed to mitigate the impact of speed humps on those with physical conditions that make passing over speed humps consistently painful. Modification of the installation could involve lower or wider humps, or deliberately placing a hump so as to allow the resident egress from the block without passing over it. The current policy of posting notices on blocks to receive speed humps will ensure that residents are properly notified.

5. Speed humps should be installed and maintained using good quality control. No humps should exceed the maximum allowable height, and if possible, humps should be installed with a height closer to 3.0 inches. All humps should slope gradually down to the street, and meet the pavement with a smooth interface. Even with careful installation, however, some humps deteriorate over time as the edges crumble or scraping vehicles gouge the pavement. The City needs to monitor these changes, respond to complaints about certain humps, and perform maintenance on humps where necessary.

6. When speed humps are installed on streets with bike lanes, care should be taken so that the humps do not adversely impact bicycle travel in the lanes. In most cases, this means that humps should not taper off within the bike lane. Instead, humps should end before crossing the lane, or should continue across the lane without tapering off. Bike lane striping should be well-maintained in order to discourage motorists from swerving in bike lanes to avoid speed humps.

7. The separate program for Special Enforcement Area speed humps should be folded into the regular program. While there may be some cases in which speed humps have helped reduce incidents of unlawful behavior like drug dealing, the evidence is not compelling enough to warrant a separate special installation program. All streets being considered for speed humps should go through the same screening criteria in order to ensure that most residents support the installation and that engineering and Fire Department concerns have been addressed. However, the priority ranking system for speed hump installation should be modified to give points to locations where the Police feel speed humps could help to mitigate drug dealing, reckless driving or other Special Enforcement issues. The points given to this condition should vary between a minimum of 1 and a maximum of 20, based on the opinion of the Police Special Enforcement Unit. A proposed Priority Ranking Form is attached at Appendix M.

8. Engineering criteria should be modified so that only streets with clear speeding problems will be considered for speed humps. Previously, any street that met the criteria for grade, width, volume, etc. could be considered. These criteria should now require that streets have an 85th percentile speed above a certain threshold, and this threshold should vary with street width. The following thresholds are suggested:

- For streets 30 feet wide or less, 85th percentile speed must be greater than 30 mph.
- For streets greater than 30 feet, 85th percentile speed must be greater than 32 mph.

A proposed Criteria Worksheet is attached as Appendix N.

9a. Proposed speed humps should be evaluated in terms of their impact on surrounding residential streets. Speed humps can potentially divert a large amount of traffic to other streets, and the City should develop a policy that evaluates proposed new speed humps based on the amount of potential traffic diversion. Adhering to this policy will require two efforts. First, the diversion impact of new speed humps should be estimated by traffic engineering staff and installation avoided or modified where this impact is likely to be significantly adverse. To do this, the speed hump criteria checklist should be modified to include a requirement that traffic engineering staff estimate which streets will receive the bulk of diverted traffic, and the magnitude of the diversion. Second, the process will require monitoring traffic volumes before

and after speed humps are installed. If post-installation monitoring identifies that a parallel street has received an unacceptable level of diversion, then the speed humps should be considered for removal or modification, or the impacted street should be considered for traffic calming.

9b. Traffic engineering staff should adopt a policy that determines what level of traffic increase is acceptable for streets receiving diverted traffic. It is recommended that as a starting point, Traffic Engineering staff consider the Impact Threshold Curve used in Portland, Oregon. This curve, included as Appendix O, identifies the maximum amount of acceptable traffic increase, based on existing volumes. It varies from a minimum average daily traffic increase of 150 to a maximum of 400. Thus, an increase of less than 150 vehicles per day is acceptable for any street, and more than 400 vehicles per day is unacceptable for any street. Within this range, the acceptable limit depends on pre-diversion volume, and is determined by the curve. These limits may need to be refined by Berkeley Traffic Engineering staff.

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SPEED HUMP CRITERIA WORKSHEET

Appendix A

Location: ______________________________ Date requested: __________

Requesting Group: ______________________ Contact: ______________________

Address: ______________________

Requested by: Telephone [ ] Letter [ ] Petition [ ] Telephone: ______________________

GENERAL SITE FEATURES

School, park or institution in block: ______________________

Bikeway: Class I (path) _____ Class II (lanes) _____ Class III (route) _____

Curb parking utilization: 0-25% _____ 26-75% _____ 76-100% _____

Direction of travel: 1-way [ ] 2-way [ ] Traffic control at end of block: None [ ] Stop [ ] Yield [ ] Signal [ ]

Direction: _____ _____ _____ _____

Special circumstances: ______________________

Time of day speeding is worst: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Days of week speeding is worst: Mon Tues Wed Thur Fri Sat Sun

Schedule for road repair/repaving: ______________________

CHARACTERISTIC	CRITERIA	ACTUAL	LOCATION MEETS CRITERIA	
			YES	NO
Road surface	Paved			
Road width	〈 40 ft.			
Number of lanes	2			
Block length	〉300 ft.			
Street classification	local			
Speed limit	25 mph			
85' percentile speed	〉30 mph			
Safe stopping distance at hump	〉200 ft.			
Daily traffic volume	500 - 4000			
Bordering land use	〉2/3 resid.			
Residents in favor of humps	〉65%			
Bus route	NO			
Primary fire route	NO			
Designated truck route	NO			

Does location meet speed hump criteria? Yes _____ No _____

Comments ______________________

Reviewed by: ______________________ **Date:** __________ Humpcrit.ws/11-92

PETITION
FOR
REQUESTING SPEED HUMPS

Appendix B

____

(Identify Street Between Intersections)

"We, the undersigned, are residents of the above block. We understand that the City of Berkeley has adopted a policy that SPEED HUMPS are recognized as one of the techniques which can be used to help manage speeding along LOCAL streets.

We understand that the City is accepting requests for SPEED HUMPS and that receiving petitions with affirmative responses from at least two thirds (2/3) of the residential addresses in the affected block is needed before the block can continue to be considered for SPEED HUMP installation."

Please send the completed PETITION sheets to the City of Berkeley, Department of Public Works, Traffic Engineering, 2001 Addison Street, 3rd Floor, Berkeley, California 94704.

SIGNATURE/PRINT NAME	COMPLETE ADDRESS	DATE

[DELEUW\SPEEDHUMP.PET]

CITY OF BERKELEY
SPEED HUMP PRIORITY RANKING

Location: ______________________ Date requested: __________

Requesting Group: ______________________ Contact: __________

Address: __________

Requested by: Telephone [ ] Letter [ ] Petition [ ] Telephone: __________

Criteria Worksheet completed __________ Location eligible __________

CATEGORY	POINT ASSIGNMENT	POINT SUMMARY
SPEED PROFILE		
	1 point/percentage of speeds over 30 mph	
	2 points/percentage of speeds over 35 mph	
ACCIDENTS RELATED TO SPEED (check 5 years of data)		
	2 points/property damage accident	
	5 points/injury accidents	
	5 points/pedestrian or bicycle accident	
SCHOOLS, PARKS & INSTITUTIONS		
	10 points each if located on block	
	1 point for each 50 feet of frontage	
BLOCK LENGTH		
	1 point for every 50 feet of block length	
ALTERNATIVE MEASURES CONSIDERED		
	5 points - Engineering (Traffic Control)	
	5 points - Enforcement (Citations)	
	5 points - Education (Residents/Others)	
	TOTAL POINTS	

Comments: ______________________

____

Date: __________ Ranking Position __________

Evaluated by: __________

NOTE: Use different form to rank requests for speed humps in special enforcement areas.

CITY OF BERKELEY -- SPEED HUMP PRIORITY RANKING

Location: ______________________________ Date requested: __________

Contact: ______________ Address: ______________ Phone: ______________

Requested by: Telephone [ ] Letter [ ] Petition [ ]

Criteria Worksheet completed ______________ Location eligible ______________

CATEGORY	POINT VALUES	POINTS
STREETS OVER 30 FT. WIDE		
SPEED % =	1 point/percentage of speeds over 30 mph	
SPEED % =	2 points/percentage of speeds over 35 mph	
STREETS 30 FT WIDE OR LESS		
SPEED % =	1 point/percentage of speeds over 26 mph	
SPEED % =	2 points/percentage of speeds over 30 mph	
ACCIDENTS RELATED TO SPEED (check five years of data)		
	2 points/property damage accident	
	5 points/injury accidents	
	5 points/pedestrian or bicycle accident	
SCHOOLS/PARKS/INSTITUTIONS		
	10 points each if located on block	
	1 point for each 50 feet of frontage	
BLOCK LENGTH - FIRST 600 FEET		
	1 point for every 50 feet of block length	
BLOCK LENGTH - OVER 600 FEET		
	1.5 points for every 50 feet over 600 feet	
ALTERNATIVES CONSIDERED		
	1-5 points - Engineering (Traffic Control)	
	1-5 points - Enforcement (Citations)	
	1-5 points - Education (Residents/Others)	
ESTIMATED DAILY TRAFFIC		
	No points for daily volumes under 1000	
	5 points for daily volumes betweem 1000-1999	
	10 points for daily volumes between 2000-2999	
	15 points for daily volumes between 3000-4000	
	TOTAL POINTS	

Comments: ______________________________

Date: ______________ Ranking Position ______________

NOTE: Use different form to rank requests for speed humps in special enforcement areas.

CITY OF BERKELEY
SPEED HUMP RANKING SHEET
FOR USE IN
SPECIAL ENFORCEMENT AREAS

LOCATION

____

Date request received ____________ Written ________ Phone ________

Contact person ______________________________

Problem statement: ______________________________

____

Is location along a local street? Yes [ ] No [ ] If yes, proceed with ranking; if no, reject

---

POLICE RANKING OF DRUG ACTIVITY IMPACT
(circle one number from 1-10)

Low impact - Reject[1]	Moderate impact	Severe impact
1 2 3	4 5 6 7	8 9 10

TRAFFIC ENGINEERING RANKING OF SPEED HUMP EFFECTIVENESS
(circle one number from 1-10)

Low - Reject[2]	Moderate	High
1 2 3	4 5 6 7	8 9 10

Rank: Impact X Effectiveness ______ X ______ = [ ]

Number of humps ______________________________

Location of humps ______________________________

____

____

____

Cost estimate ______________________________

Construction by: City: ____________ Other: ____________

Implementation Schedule: ______________________________

Completion Date: ______________________________

---

[1] Speed hump requests with drug impact rankings of less than 4 do not qualify as being within a special enforcement area and should be returned to the regular request list.

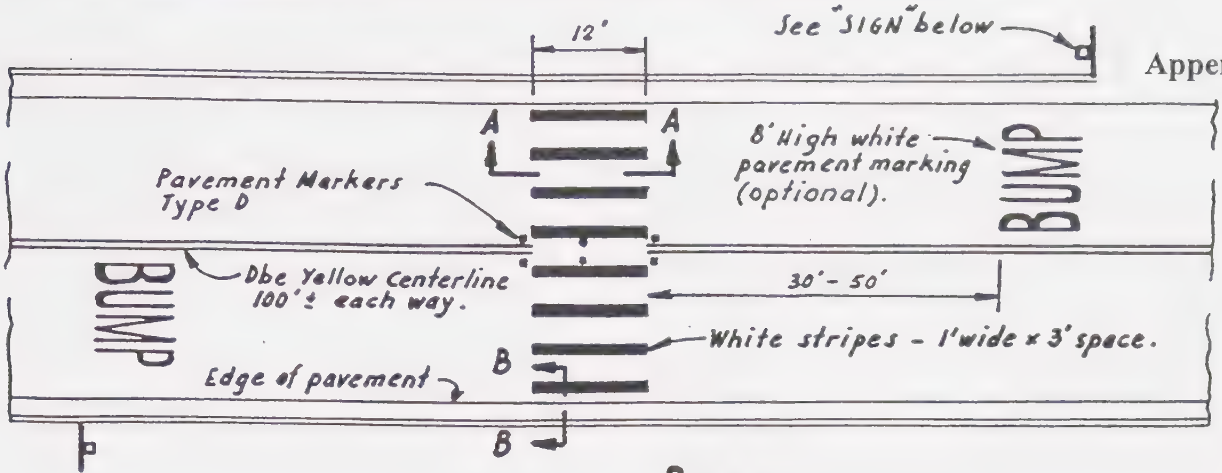
[2] Consider actions other than speed humps where effectiveness rating is less than 4.

Appendix F: Speed Hump Locations in Berkeley

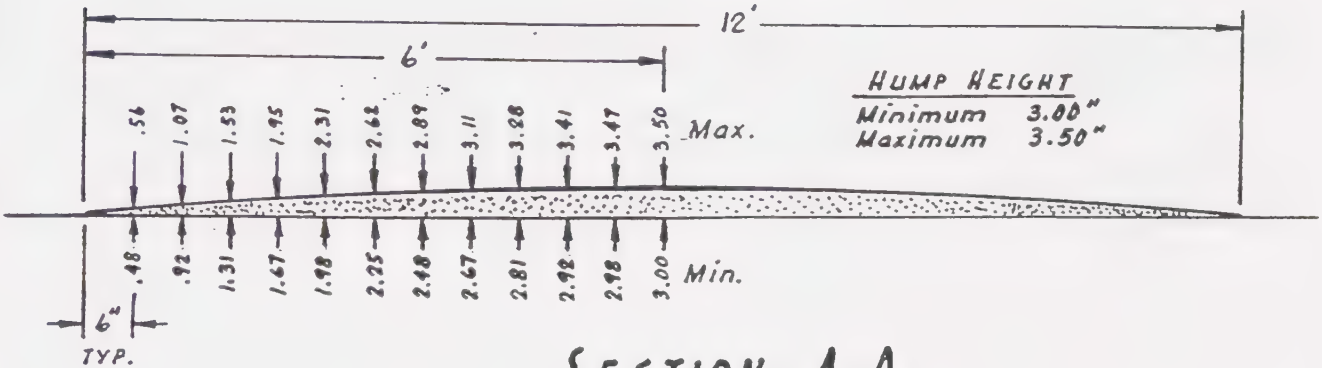
Street Name	X-Street (N,W)	X-Street (S,E)	Direction	# of humps	Date installed	Street Width	Dist b/w Humps	Note
ACTON	Addison	Allston	N-S	2	Aug 1995	26		
ACTON	Carrison	Haskel	N-S	1	Mar 1994	36		SEA
ACTON	Haskell	67th	N-S	1	Mar 1994	36		SEA
ALLSTON	7th	8th	W-E	1	Mar 1994	36		SEA
ALLSTON	8th	9th	W-E	1	Mar 1994	36		SEA
BANCROFT	7th	8th	W-E	1	Mar 1994	36		SEA
BANCROFT	8th	9th	W-E	1	Mar 1994	36		SEA
BERKELEY	Chestnut	West	W-E	1	by Jan 1995	24		SEA?
BERKELEY	West	Acton	W-E	2	by Jan 1995	36		SEA?
BONAR	Allston	Bancroft	N-S	2	Aug 1995	36		
CAPISTRANO	Colusa	The Alameda	W-E	3	by Jan 1995	26	250', 180'	
CARRISON	San Pablo	Mabel	W-E	3	Jan 1990	36	200-240'	SEA
CATALINA	Colusa	Sta. Place	W-E	1	by Jan 1995	26		
CATALINA	Sta. Place	The Alameda	W-E	1	by Jan 1995	26		
CHANNING	Milvia	Shattuck	W-E	2	Mar 1994	36		SEA
CORNELL	City Limits	Gilman	N-S	2	Aug 1995	30		
CURTIS	Cedar	Virginia	N-S	2	Mar 1994	30		SEA
CURTIS	Gilman	Hopkins	N-S	4	Aug 1995	36(S), 30(N)		
DERBY	Ellsworth	Dana	W-E	2	by Mar 1993	36	200'	
DERBY	Fulton	Ellsworth	W-E	2	by Mar 1993	36	200'	
DERBY	Shattuck	Fulton	W-E	2	by Mar 1993	36	200'	
DERBY	Mabel	Acton	W-E	2	by Jan 1995	36	200'	
EL CAMINO	Domingo	The Uplands	W-E	3	by Jan 1995	25		
ELLIS	Fairview	Harmon	N-S	1	Mar 1994	37.57		SEA
ELLIS	Woolsey	Fairview	N-S	1	Mar 1994	37.57		SEA
FAIRVIEW	Adeline	Dover	W-E	1	Mar 1994	36		SEA
FAIRVIEW	Ellis	Harper	W-E	2	Mar 1994	36		SEA
FAIRVIEW	Harper	Adeline	W-E	1	Mar 1994	36		SEA
FAIRVIEW	Sacramento	California	W-E	2	Mar 1994	36		SEA
HARMON	Adeline	Tremont	W-E	1	Mar 1990	36		SEA?
HARMON	Ellis	Adeline	W-E	1	Mar 1994	36		SEA
HARMON	King	Ellis	W-E	1	Mar 1994	36		SEA
HARPER	Russell	Ashby	N-S	1	Mar 1994	36		SEA
HASKELL	Mabel	Acton	W-E	2	Mar 1994	36		SEA
HASKELL	San Pablo	Mabel	W-E	2	Mar 1990	36	300'	SEA
KAINS	Camelia	Page	N-S	1	Mar 1994	30		SEA
KAINS	Gilman	Camelia	N-S	1	Mar 1994	30		SEA
KAINS	Harrison	Gilman	N-S	2	Mar 1994	30		SEA

Street Name	X-Street (N,W)	X-Street (S,E)	Direction	# of humps	Date installed	Street Width	Dist b/w Humps	Note
KING	Fairview	Harmon	N-S	1	by Jan 1995	37.57		SEA?
KING	Prince	Woolsey	N-S	1	Mar 1994	37.57		SEA
KING	Tyler	Prince	N-S	1	Mar 1994	37.57		SEA
M.L. KING	63rd	62nd	N-S	1	Mar 1994	32		SEA
MABEL	67th	66th	N-S	1	Mar 1994	36		SEA
MABEL	Oregon	Russell	N-S	1	Mar 1994	36		SEA
MABEL	Ward	Oregon	N-S	2	Mar 1994	36		SEA
MASONIC	City Limits	Gilman	N-S	2	Nov 1990	30		
MILVIA	Cedar	Lincoln	N-S	1	Apr 1990	36		
MILVIA	Delaware	Hearst	N-S	1	Apr 1990	40		
MILVIA	Francisco	Delaware	N-S	2	Apr 1990	40		
MILVIA	Hearst	Berkeley Way	N-S	1	Apr 1990	40		
MILVIA	Virginia	Francisco	N-S	1	Apr 1990	40		
OREGON	California	McGee	W-E	2	by Sept 94	36		SEA
OREGON	McGee	Grant	W-E	2	by Sept 94	36		SEA
OREGON	San Pablo	Wallace	W-E	1	Mar 1994	36		SEA
OREGON	Wallace	Mathews	W-E	1	Mar 1994	36		SEA
OXFORD	Eunice	Rose	N-S	2	Jan 1990	36		
PARK	Oregon	Russel	N-S	1	Mar 1994	36		SEA
PARK	Ward	Oregon	N-S	2	Mar 1994	36		SEA
PERALTA	City Limits	Gilman	N-S	2	by Jan 1995	42		
PRINCE	California	King	W-E	2	Mar 1994	36		SEA
PRINCE	Sacramento	California	W-E	2	Mar 1994	36		SEA
RUSSELL	California	McGee	W-E	2	Mar 1994	36		SEA
RUSSELL	Grant	M.L. King	W-E	1	Mar 1994	36		SEA
RUSSELL	Mabel	Park	W-E	1	Mar 1994	36		SEA
RUSSELL	McGee	Grant	W-E	1	Mar 1994	36		SEA
RUSSELL	Sacramento	California	W-E	2	Mar 1994	36		SEA
SAN PEDRO	Colusa	The Alameda	W-E	2	?	26		
SANTA FE	Gilman	Camelia	N-S	2	by mid-1996	30	300'	22' humps
TACOMA	Colusa	The Alameda	W-E	2	by Jan 1995	26		
THE UPLANDS	Parkside	Hillcrest	W-E	4	by Sept 94	28		
TYLER	California	King	W-E	2	?	36		SEA?
TYLER	Sacramento	California	W-E	2	by Jan 1995	36	160'	SEA?
WARD	Mabel	Park	W-E	1	Mar 1994	36		SEA
WARD	Mathews	Mabel	W-E	1	Mar 1994	36		SEA
WARD	McGee	Grant	W-E	2	Mar 1994	36		SEA
WARD	San Pablo	Wallace	W-E	1	Mar 1994	36		SEA

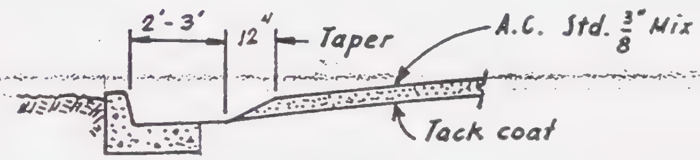
Street Name	X-Street (N,W)	X-Street (S,E)	Direction	# of humps	Date installed	Street Width	Dist b/w Humps	Note
WOOLSEY	California	King	W-E	2	Mar 1994	36		SEA
WOOLSEY	Ellis	Harper	W-E	1	Mar 1994	36		SEA
WOOLSEY	King	Ellis	W-E	1	Mar 1994	36		SEA
WOOLSEY	Sacramento	California	W-E	2	Mar 1994	36		SEA
10TH	Bancroft	Channing	N-S	1	Mar 1994	36		SEA
10TH	Channing	Dwight	N-S	2	Mar 1994	36		SEA
10TH	Delaware	Hearst	N-S	1	Mar 1994	36		SEA
10TH	Hearst	University	N-S	1	Mar 1994	36		SEA
10TH	Virginia	Delaware	N-S	2	Mar 1994	36		SEA
62ND	California	King	W-E	2	Mar 1994	36		SEA
63RD	California	King	W-E	2	Mar 1994	36		SEA
66TH	Baker	Sacramento	W-E	1	Mar 1994	36		SEA
66TH	Boise	Acton	W-E	1	Mar 1994	36		SEA
66TH	Idaho	Boise	W-E	1	Mar 1994	36		SEA
67TH	Mabel	Acton	W-E	2	Mar 1994	30		SEA
7TH	Allston	Bancroft	N-S	2	Mar 1994	36		SEA
7TH	Channing	Dwight	N-S	1	by Jan 1995	36		SEA?
7TH	Delaware	Hearst	N-S	2	Mar 1994	36		SEA
7TH	Virginia	Delaware	N-S	2	Mar 1994	36		SEA
8TH	Bancroft	Channing	N-S	2	by Sept 94	36		SEA?
8TH	Virginia	Delaware	N-S	2	Mar 1994	36		SEA
9TH	Addison	Allston	N-S	2	Mar 1994	48		SEA
9TH	Allston	Bancroft	N-S	2	Mar 1994	48		SEA



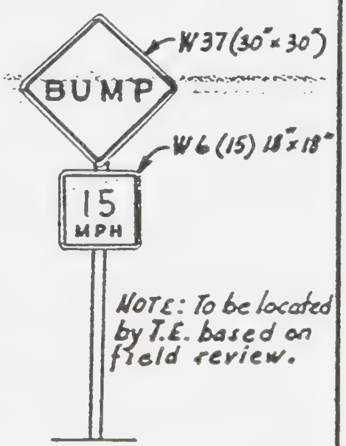
PLAN



SECTION A-A



SECTION B-B



SIGN

GENERAL NOTES:

1. Speed humps shall not be placed over manholes, watergates, etc.
2. Edge of Speed Hump shall be at least 5' away from edge of driveway.
3. Whenever possible Speed Humps should be placed at property lines instead of mid-lot.
4. Whenever possible Speed Humps should be placed adjacent to street lights.
5. All markings and signs shall be reflective.

REGISTERED PROFESSIONAL ENGINEER
Brian C. Lee
No. 26573
Exp. 3-31-92
CIVIL
STATE OF CALIFORNIA

CITY OF BERKELEY DEPARTMENT OF PUBLIC WORKS		STD. SPEED HUMP		
SUBMITTED: Charles E. DeLeuw Jr. TRAFFIC ENGINEER	DATE: 1-8-90 R.T.E. 541			
APPROVED: Brian C. Lee DIRECTOR OF PUBLIC WORKS	DATE: 1-8-90 R.C.E. 26573	DESIGN BY: CED DRAWN BY: fn CHECKED BY:	DATE: 1-5-90 SCALE: nts BOOK:	PLAN: FILE:

Appendix H: Berkeley Resident Speed Hump Survey *Results*

Dec 1996 - Jan 1997

	Blocks with Humps (n=366)	Blocks without Humps (n=342)	All Blocks (n=708)
How do you usually travel around Berkeley?			
Car	75%	75%	76%
Bicycle	4%	5%	4%
Walk	6%	4%	5%
Bus	3%	2%	3%
Other	-	-	-
(multiple or no response)	12%	14%	13%
When you travel around Berkeley, do you avoid streets with speed humps where possible?			
Yes, always	10%	16%	13%
Yes, sometimes	39%	44%	42%
No	47%	37%	43%
No Opinion	3%	1%	2%
(multiple or no response)	1%	2%	2%
Is there a speed hump directly in front of your house?			
Yes	54%	n.a.	
No	46%	n.a.	
(multiple or no response)	<1%		
Have you noticed a change in traffic speeds on your block since the speed humps were installed?		***(...on nearby blocks?)***	
Higher speeds	2%	23%	
Lower speeds	65%	17%	
No change	15%	29%	
Don't know	15%	21%	
(multiple or no response)	2%	10%	
Respondants with speed humps in front of house ("yes" on Q3, n=197)			
Higher speeds	2%		
Lower speeds	68%		
No change	13%		
Don't know	14%		
(multiple or no response)	3%		
Respondants living at site "More than 6 years"	(n=232)	(n=227)	
Higher speeds	3%	23%	
Lower speeds	73%	18%	
No change	18%	32%	
Don't know	5%	16%	
(multiple or no response)	2%	11%	
Respondants with "Children in the household under the age of 13"	(n=105)	(n=93)	
Higher speeds	1%	31%	
Lower speeds	66%	16%	
No change	15%	24%	
Don't know	15%	19%	
(multiple or no response)	3%	10%	

	Blocks with Humps (n=366)	Blocks without Humps (n=342)
Have you noticed a change in the number of vehicles driving on your block since the speed humps were installed?		**(...on nearby blocks?)**
More vehicles	3%	27%
Fewer vehicles	30%	7%
No change	39%	31%
Don't know	27%	28%
(multiple or no response)	2%	8%
Respondants with speed humps in front of house ("yes" on Q3, n=197)		
More vehicles	3%	
Fewer vehicles	32%	
No change	38%	
Don't know	26%	
(multiple or no response)	1%	
Respondants living at site "More than 6 years"	(n=232)	(n=227)
More vehicles	4%	29%
Fewer vehicles	34%	6%
No change	43%	36%
Don't know	17%	20%
(multiple or no response)	2%	10%
Respondants with "Children in the household under the age of 13"	(n=105)	(n=93)
More vehicles	1%	32%
Fewer vehicles	37%	9%
No change	36%	27%
Don't know	24%	26%
(multiple or no response)	2%	7%
Have you noticed a change in traffic noise on your block since the speed humps were installed?		
More noise	12%	n.a.
Less noise	40%	n.a.
No change	26%	n.a.
Don't know	18%	n.a.
(multiple or no response)	4%	
Respondants with speed humps in front of house ("yes" on Q3, n=197)		
More noise	17%	
Less noise	39%	
No change	21%	
Don't know	20%	
(multiple or no response)	3%	
Respondants living at site "More than 6 years" (n=232)		
More noise	13%	
Less noise	45%	
No change	29%	
Don't know	9%	
(multiple or no response)	4%	
Respondants with "Children in the household under the age of 13" (n=105)		
More noise	14%	
Less noise	45%	
No change	25%	
Don't know	13%	
(multiple or no response)	3%	

	Blocks with Humps	Blocks without Humps	All Blocks
	(n=366)	(n=342)	(n=708)
Speed humps delay fire trucks and ambulances responding to emergencies. More than one minute may be added to the average response time of four minutes. Do you feel this is reason for the city to avoid adding new speed humps?			
Yes	23%	42%	33%
No	48%	35%	42%
Not sure	26%	20%	23%
(multiple or no response)	3%	3%	3%
Respondants living at site "More than 6 years"			
	(n=232)	(n=227)	(n=459)
Yes	25%	45%	34%
No	47%	32%	39%
Not sure	26%	21%	24%
(multiple or no response)	3%	3%	3%
Respondants with "Children in the household under the age of 13"			
	(n=105)	(n=93)	(n=198)
Yes	19%	31%	25%
No	52%	42%	47%
Not sure	27%	20%	24%
(multiple or no response)	2%	7%	4%
Do you think the speed humps have had any effect on crime in your neighborhood?			
Increased crime	1%	2%	
Decreased crime	20%	11%	
No effect	30%	32%	
Don't know	45%	52%	
(multiple or no response)	4%	3%	
Respondents living in Special Enforcement Areas only			
	(n=231)	(n=195)	
Increased crime	< 1%	3%	
Decreased crime	24%	14%	
No effect	29%	30%	
Don't know	41%	50%	
(multiple or no response)	6%	3%	
Do you experience pain or severe discomfort when driving over speed humps in Berkeley at the posted speed?			
Always	2%	5%	4%
Sometimes	14%	11%	13%
No	81%	82%	82%
(multiple or no response)	2%	2%	2%

	Blocks with Humps (n=366)	Blocks without Humps (n=342)	All Blocks (n=708)
Overall, how do you feel about the speed humps on your block?			
Like them	67%	n.a.	
Dislike them	18%	n.a.	
No opinion	12%	n.a.	
(multiple or no response)	4%		
Respondants with speed humps in front of house ("yes" on Q3, n=197)			
Like them	71%		
Dislike them	17%		
No opinion	7%		
(multiple or no response)	5%		
Respondants living at site "More than 6 years" (n=232)			
Like them	65%		
Dislike them	20%		
No opinion	12%		
(multiple or no response)	3%		
Respondants with "Children in the household under the age of 13" (n=105)			
Like them	73%		
Dislike them	15%		
No opinion	9%		
(multiple or no response)	3%		
Would you be interested in having speed humps on your block?			
Yes	n.a.	38%	
No	n.a.	50%	
Maybe	n.a.	11%	
(multiple or no response)		1%	
Respondants living at site "More than 6 years" (n=227)			
Yes		35%	
No		53%	
Maybe		10%	
(multiple or no response)		1%	
Respondants with "Children in the household under the age of 13" (n=93)			
Yes		54%	
No		38%	
Maybe		9%	
(multiple or no response)		0%	
How would you feel about the installation of speed humps on <u>other</u> blocks if residents wanted them?			
Support new humps	57%	46%	52%
Oppose new humps	13%	29%	21%
No opinion	25%	23%	24%
(multiple or no response)	5%	2%	4%
How long have you lived on this block?			
Less than 1 year	6%	7%	6%
1 - 3 years	18%	16%	17%
4 - 6 years	10%	10%	10%
More than 6 years	64%	67%	66%
(multiple or no response)	1%	1%	1%

	Blocks with Humps (n=366)	Blocks without Humps (n=342)	All Blocks (n=708)
Are there any children in your household under the age of 13?			
Yes	29%	27%	28%
No	69%	71%	71%
(multiple or no response)	2%	2%	2%

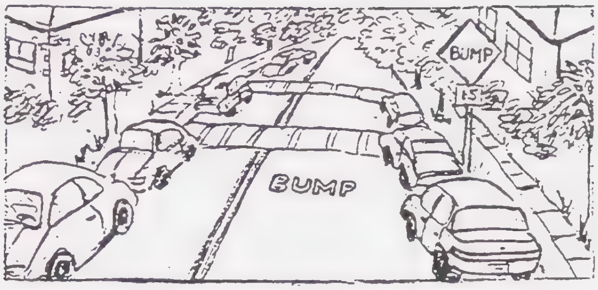
Percentages may not total 100 because of rounding

CITY OF BERKELEY

Planning and Development Department
2118 Milvia Street, 3rd Floor
Berkeley, California 94704
(510) 705 8101 • FAX (510) 883 6565
E-mail address: planning@ci.berkeley.ca.us

Appendix I-1

November 1996



RESIDENT SPEED HUMP SURVEY

Dear Resident,

The City of Berkeley is evaluating its speed hump program. Learning how residents feel about the program is an important part of our evaluation. Your input will help determine the future of the speed hump program. Please take a minute to give us your opinions. All information will be kept confidential.

Please circle your response and return the survey in the enclosed stamped envelope by December 7, 1996.

Thank you for your assistance.

---

1. How do you usually travel around Berkeley? (circle one only)

   Car   Bicycle   Walk   Bus   Other______________

2. When you travel around Berkeley, do you avoid streets with speed humps where possible?

   Yes, always   Yes, sometimes   No   No opinion

3. Is there a speed hump directly in front of your house?

   Yes   No

4. Have you noticed a change in **traffic speeds** on your block since the speed humps were installed?

   Higher speeds   Lower speeds   No change   Don't know

5. Have you noticed a change in the **number of vehicles** driving on your block since the speed humps were installed?

   More vehicles   Fewer vehicles   No change   Don't know

Please turn over

6. Have you noticed a change in **traffic noise** on <u>your block</u> since the speed humps were installed?

More noise   Less noise   No change   Don't know

7. Speed humps delay fire trucks and ambulances responding to emergencies. More than one minute may be added to the average response time of four minutes. Do you feel this is a reason for the city to avoid adding new speed humps?

Yes   No   Not sure

8. Do you think the speed humps have had any effect on crime in your neighborhood?

Increased crime   Decreased crime   No effect   Don't know

9. Do you experience pain or severe discomfort when driving over speed humps in Berkeley at the posted speed?

Always   Sometimes   No

If Always or Sometimes, please explain:

10. Overall, how do you feel about the speed humps on your block?

Like them   Dislike them   No opinion

11. How would you feel about the installation of speed humps on <u>other</u> blocks if residents wanted them?

Support new humps   Oppose new humps   No opinion

12. How long have you lived on this block?

Less than 1 year   1 - 3 years   4 - 6 years   More than 6 years

13. Are there any children in your household under the age of 13?

Yes   No

14. Additional comments: ____

____

____

CITY OF BERKELEY

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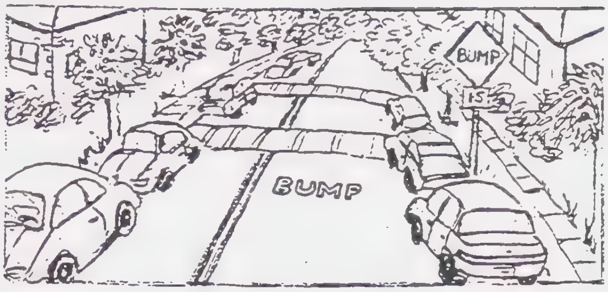
November 1996



RESIDENT SPEED HUMP SURVEY

Dear Resident,

The City of Berkeley is evaluating its speed hump program. Learning how residents feel about the program is an important part of our evaluation. Your input will help determine the future of the speed hump program. Please take a minute to give us your opinions. All information will be kept confidential.

Please circle your response and return the survey in the enclosed stamped envelope by December 7, 1996.

Thank you for your assistance.

---

1. How do you usually travel around Berkeley? (circle one only)

   Car   Bicycle   Walk   Bus   Other ______________

2. When you travel around Berkeley, do you avoid streets with speed humps where possible?

   Yes, always   Yes, sometimes   No   No opinion

3. Have you noticed a change in **traffic speeds** on your block since speed humps were installed on nearby blocks?

   Higher speeds   Lower speeds   No change   Don't know

4. Have you noticed a change in the **number of vehicles** driving on your block since speed humps were installed on nearby blocks?

   More vehicles   Fewer vehicles   No change   Don't know

Please turn over

5. Speed humps delay fire trucks and ambulances responding to emergencies. More than one minute may be added to the average response time of four minutes. Do you feel this is a reason for the city to avoid adding new speed humps?

Yes   No   Not sure

6. Do you think the speed humps on nearby blocks have had any effect on crime in your neighborhood?

Increased crime   Decreased crime   No effect   Don't know

7. Do you experience pain or severe discomfort when driving over speed humps in Berkeley at the posted speed?

Always   Sometimes   No

If Always or Sometimes, please explain:

8. Would you be interested in having speed humps on your block? *

Yes   No   Maybe

9. How would you feel about the installation of speed humps on <u>other</u> blocks if residents wanted them?

Support new humps   Oppose new humps   No opinion

10. How long have you lived on this block?

Less than 1 year   1 - 3 years   4 - 6 years   More than 6 years

11. Are there any children in your household under the age of 13?

Yes   No

12. Additional comments: ____

____

____

* New speed humps will not be installed based on the response to this question.

1

City of Berkeley
Designated Fire Routes

Appendix K is a large map (in draft form) of Primary, Secondary and Tertiary Emergency Response Routes which has not yet been reproduced.

PETITION FOR REQUESTING SPEED HUMPS

____

(Identify Street Between Intersections)

"We, the undersigned, are residents of the above block. We understand that the City of Berkeley has adopted a policy that SPEED HUMPS are recognized as one of the techniques which can be used to help manage speeding along LOCAL streets.

We understand that the installation of speed humps may cause delay to emergency response vehicles. The average response time goal of the Berkeley Fire Department is 4 minutes. Tests in Berkeley have shown that a block with two speed humps can delay fire engines by up to 20 seconds.

We understand that the City is accepting requests for SPEED HUMPS and that receiving petitions with affirmative responses from at least two-thirds (2/3) of the residential addresses in the affected block is needed before the block can continue to be considered for SPEED HUMP installation."

Please send the completed petition sheets to the City of Berkeley, Department of Public Works, Traffic Engineering, 2201 Dwight Way, Berkeley, CA, 94704.

SIGNATURE / PRINT NAME	COMPLETE ADDRESS	DATE

SPEED HUMP PRIORITY RANKING, CITY OF BERKELEY

Appendix M

Location:________________________________ Date requested:__________
Contact: ________________ Address:________________ Phone:__________
Requested by: Telephone [ ] Letter [ ] Petition [ ] In Person [ ]
Criteria Worksheet completed:________________ Location eligible:__________

CATEGORY	POINT VALUES	POINTS
STREETS OVER 30 FT. WIDE		
Speed % =	1 point/percentage of speeds over 30 mph	
Speed % =	2 points/percentage of speeds over 35 mph	
STREETS 30 FT WIDE OR LESS		
Speed % =	1 point/percentage of speeds over 30 mph	
Speed % =	2 points/percentage of speeds over 35 mph	
ACCIDENTS RELATED TO SPEED	(check five years of data)	
	2 points/property damage accident	
	5 points/injury accidents	
	5 points/pedestrian or bicycle accident	
SCHOOLS/PARKS/INSTITUTIONS		
	10 points each if located on block	
	1 point each for 50 feet of frontage	
BLOCK LENGTH - FIRST 600 FEET		
	1 point for every 50 feet of block length	
BLOCK LENGTH - OVER 600 FEET		
	1.5 points for every 50 feet over 600 feet	
ALTERNATIVES TRIED		
	1-5 points - Engineering (Traffic Control)	
	1-5 points - Selective Enforcement (Traffic Police)	
	1-5 points - Education (Neighborhood Programs)	
ESTIMATED DAILY TRAFFIC		
	No points for daily volumes under 1000	
	5 points for daily volumes between 1000 and 1999	
	10 points for daily volumes between 2000 and 2999	
	15 points for daily volumes between 3000 and 4000	
SPECIAL ENFORCEMENT AREA		
	0 points if not in Special Enforcement Area	
	1-20 points: Police estimate of SEU-related activity	
	TOTAL POINTS	

Comments:____

Date:____________ Ranking Position:______________

SPEED HUMP CRITERIA WORKSHEET, CITY OF BERKELEY

Location: ______________________________ Date requested: ______________

Requesting Group: ______________________ Contact: ______________________

Contact Address: _______________________ Contact Phone: ________________

Requested by: Telephone [ ] Letter [ ] Petition [ ] In Person [ ]

GENERAL SITE FEATURES

School or park on block: ____

Bikeway: Class I (path) _____ Class II (lanes) _____ Class III (route) _____

Curb parking utilization: 0-25% _____ 26-75% _____ 76-100% _____

Direction of Travel: 1-way [ ] 2-way [ ] Traffic control at end of block: None [ ] Stop [ ] Yield [ ] Signal [ ]
Direction: _____ _____ _____ _____

Special circumstances: ____

Time of day most speeding is observed: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Day of the week most speeding is observed: Mon Tues Wed Thurs Fri Sat Sun

Schedule for road repair/repaving: ____________________________________

CHARACTERISTIC	CRITERIA	ACTUAL	LOCATION MEETS CRITERIA	
			YES	NO
Road surface	Paved			
Road width	< 40 ft			
Number of lanes	2			
Block length	> 300 ft			
Street classification	local			
Speed limit	25 mph			
85th percentile speed	> 32 mph (over 30 ft wide)			
	> 30 mph (30 ft wide or less)			
Safe stopping distance at hump	> 200 ft			
Daily traffic volume	0 - 4000			
Bordering land use	> 2/3 residential			
Residents in favor of humps	> 65%			
Bus route	No			
Primary Fire Response Route	No			
Desinated Truck Route	No			

SPEED HUMP CRITERIA WORKSHEET, Page 2

Does location meet speed hump criteria? Yes _____ No _____

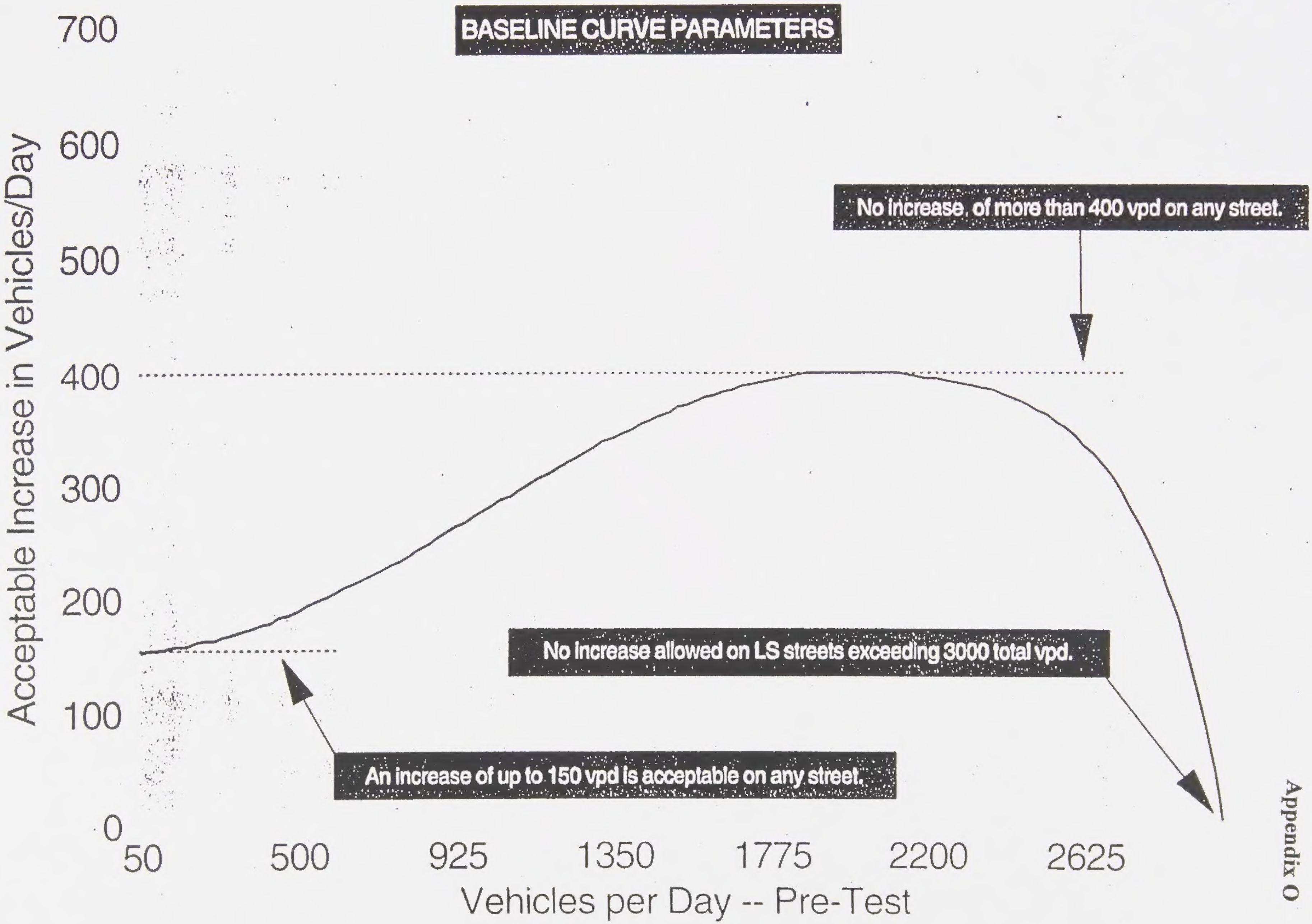
If speed humps are installed, which other street(s) are likely to get the most diverted traffic?
For each street, what is the estimated existing ADT and the estimated increase if the speed humps are installed?

Streets	Estimated existing ADT	Estimated increase in ADT
1. ______________________	______________	______________
2. ______________________	______________	______________
3. ______________________	______________	______________

Comments: ____

Reviewed by: ____ Date: ___________________

ACCEPTABLE INCREASES IN TRAFFIC VOLUME
ON NON-PROJECT STREETS



Appendix O